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INDUSTRIAL WATER USE

Willis G. Eichberger

Public Health Service
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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

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Willis G. Eichberger*

Introduction

The Public Health Service cooperates with other Federal water resources development agencies wherein it estimates for those agencies the industrial water use requirements and/or waste loadings from industrial plants and their impacts on water quality during the projected life of a proposed project. In doing so, it is necessary to determine or estimate quantities of water used by each type of manufacturing industry if an adequate water supply and pollution control study of water resources development is to be made of any given project.

In water resources development project studies it is essential that an industrial water use base be established. That is, we must have a reasonable estimate of the quantity of water used at the present time by each of the various types of manufacturing industries. Of course the best source of information in making such a base study is the industries themselves. Such information could be obtained by sampling (in areas of heavy industrial development) or by a more or less complete census of manufacturing plants. However, in studies of small water resources development projects in which the Public Health Service is engaged with other agencies, this approach is impractical and well-nigh impossible because of constraints on resources and time available for such studies. Therefore, we must look to whatever sources of secondary data are available that might serve our needs. Whatever data are used from whatever source they must serve two basic purposes: (1) To establish a base for estimating present industrial water use requirements and waste loadings by type of manufacturing industry, and (2) To provide a base from which valid projections of industrial water use requirements can be made.

The Standard Industrial Classification

Most of the industrial employment, production, and water use data available from U. S. Census of Manufactures reports are based on the Standard Industrial Classification. Because of this and also because all personnel using industrial data are not familiar with the classification and what it implies, it appears that a brief explanation is in order. The Standard Industrial Classification was developed for use in the classification of establishments by type of activity in which engaged; for purposes of facilitating the collection, tabulation, presentation, and analysis of data relating to establishments; and for promoting uniformity and comparability in the presentation of statistical data collected by various agencies of the United States Government, State agencies, trade associations, and private research organizations. 1/

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The classification was prepared by the Technical Committee on Standard Industrial Classification, assisted by a number of special committees of experts in various fields of business. The work of the Technical Committee was carried on under the sponsorship and general supervision of the Office of Statistical Standards of the Bureau of the Budget, Executive Office of the President. 1/ In establishing the standards for industrial classification, each field of economic activity was first defined. For example, Agriculture, Forestry, and Fisheries was defined as a major field of economic activity within the overall economy of the Nation. Other major divisions of economic activity include Mining; Contract Construction; Manufacturing; Transportation; Communication, Electric, Gas, and Sanitary Services; Wholesale and Retail Trade; Finance, Insurance, and Real Estate Services; Government; and Nonclassifiable Establishments. Each of the fields of economic activity was divided into major groups, type of industry, and specific industries. For purposes of classification and identification these were termed two-digit, three-digit, and four-digit industry categories, respectively.

This paper is concerned solely with manufacturing as a major division of economic activity. This division is divided into 21 major industry groups, commonly referred to as two-digit categories as shown in the following table.

1/Standard Industrial Classification Manual, Executive Office of the President, Bureau of the Budget, 1957. Government Printing Office, Washington, D. C., pp. 1 & 2.

Major two-digit groups in the manufacturing division 2/

SIC No.	Industry Group
19	Ordnance and accessories
20*	1 Food and kindred products
21	Tobacco manufactures
22	Textile mill products
23	Apparel and other finished products made from fabrics and similar materials
24	Lumber and wood products, except furniture
25	Furniture and fixtures
26*	2 Paper and allied products
27	Printing, publishing, and allied industries
28*	3 Chemicals and allied products
29*	4 Petroleum refining and related industries
30	Rubber and miscellaneous plastics products
31	Leather and leather products
32	Stone, clay, and glass products
33*	5 Primary metal industries
34	Fabricated metal products, except ordnance, machinery, and transportation equipment
35	Machinery, except electrical
36	Electrical machinery, equipment, and supplies
37	Transportation equipment
38	Professional, scientific, and controlling instruments; photographic and optical goods; watches, and clocks
39	Miscellaneous manufacturing industries

*Heavy water-using industry groups

2/ Industrial classification by two-, three-, and four-digit industry categories are given in the pages at the end of this paper. For a detailed description of the products in each four-digit classification see the Standard Industrial Classification Manual.

4.

The heavy water-using industry groups are considered to be those which have either a large water intake requirement or waste loads which contribute heavily to pollution, or both. In addition to the heavy water-using industry groups shown in the table, some of the specific manufacturing industries within some of the other major groups also have large water intake requirements or are heavy contributors of pollution.

Obviously, the two-digit industry group is too broad for most Public Health Service use because it includes all products within a major group, not all of which are heavy water users or heavy contributors of pollution. For example, SIC 20, Food and Kindred Products, includes such manufacturing industries as bakeries which do not have a significant water requirement or do not contribute significantly to pollution, as well as meat packing plants which have a very significant impact on the water resource.

The next division of the industrial classification is the three-digit category. Here again, the category is too broad for Public Health Service use. Taking the Food and Kindred Products industry (SIC 20) again as an example, SIC 201 (the three-digit division) consists of meat products. This category, however, does not allow a fine enough division of the Food and Kindred Products industry for our purposes because it includes sausages and other prepared meats as well as meat packing plants. The former does not have nearly so large an impact on the water resource as the latter. Therefore, we must, whenever possible, rely upon a four-digit division which gets down to a specific industry; for example, SIC 2011, meat packing plants. This idea has been followed throughout in the development of industrial water use requirement data developed in this paper.

Water use statistics are most meaningful when examined on a four-digit basis and related to the processes, products, employment, and value added by manufacture data at that level. Differences in manufacturing processes are not so great at the four-digit level as at the higher order two-digit level. Also, aggregations at the two-digit level represent totals for industries which differ widely in processes used, materials fabricated, or products produced.

Sources of Data Used

Quantities of water used by various industries in the United States are not known with any degree of certainty. Industrial water use data available are very meager, and in many cases the literature provides conflicting data. To date it appears that the 1959 Census of Industrial Water Use is the best source of information needed for industrial water supply studies. 3/

The 1959 census report on industrial water use gives information for most manufacturing industries using 20 million gallons or more of water per year, on total water intake, quantities of intake water used for various in-plant purposes (process, steam electric generating, other cooling and condensing, boiler feed, etc.), and total water discharged. The census data also provide information on the number of establishments that recirculate or reuse water, the purposes and quantities of water for which recirculation is used, and gross water use by each industry including recirculation or reuse.

Although data on industrial water use as presented in the 1959 census report are the best available, they do not provide the type of information that would be most desirable to make an adequate analysis of the industrial water use problem. For example, ideally we should have historic data that show trends in quantities of water used by various types of manufacturing industries through time. Also, although the census report shows total quantity of water discharged by each of the various types of manufacturing industries, information is needed on the quantities of process water and cooling water discharged separately.

Some data pertaining to changes in quantities of water used by industrial plants through time are available and are presented in a subsequent section on Trends in Industrial Water Use.

Data on industrial (manufacturing) employment were available from the 1958 Census of Manufactures, Industry Statistics 4/ in reports published by the Bureau of the Census. These volumes provide statistics on employment in two-, three-, and four-digit industry categories. Also available from the same statistics were data relating to value added by manufacture. Production and output data were available for most types of manufacturing by quantity of units of total production by four-digit industry. For some types of manufacturing, however, data on output were available only in terms of quantity of products shipped. These were used as indicators of total production.

3/ 1959 Census of Manufactures Industrial Water Use. Bureau of Census, U. S. Department of Commerce. Subject Report MC58(1)-11. U. S. Government Printing Office, Washington, D. C., 1961.

4/ U. S. Bureau of the Census. U. S. Census of Manufactures, 1958. Vols. I & II, Industry Statistics, Parts 1 & 2. U. S. Government Printing Office, Washington, D. C., 1961.

Unfortunately, production and output data were not available for all heavy water-using industries. This was primarily because the units of output were not additive due to the nature of products produced by a given four-digit industry (such as the chemical industry which produces multiple products in many different units of measurement). Output for such industries can be added only in terms of dollar value of product.

Computation and Analysis of the Data

Data available from the industrial water use census of 1959 are for those manufacturing establishments using 20 million or more gallons of water per year. These establishments account for more than 90 percent of the industrial water use. However, they employ only 41 percent of the total number of people engaged in manufacturing and produce only about 51 percent of the value added by manufacture. Because the data contained in the industrial water use census report pertain only to the large water users, they cannot be used to derive estimates of total industrial water use. They are useful, however, when used in conjunction with other census of manufacturing data, to derive estimates of water use for specific industries.

In order to determine to just what extent the available data will serve the purposes of Public Health Service personnel engaged in making water resource development studies, all readily available industrial water use data, together with industrial output and production data, were analyzed. These analyses included not only industrial water use but also employment, value added by manufacture, and output and production by type of manufacturing enterprise. Data relating to all of these subjects are available and have been put together in such form that they can profitably be used by engineers and economists.

Industrial water use data have been developed in this paper for all two-digit industry groups at the national level. Data were also developed at the national level for all four-digit industries which had sufficient data available. The production and output data by four-digit category, as reported in the Census of Manufactures Industry Statistics, 1958, were correlated with industrial water use data as reported in the Census of Industrial Water Use, 1959.

Water use data were also developed at the two-digit level (and at the four-digit level where data were available) by industry for each region as delineated by the Bureau of the Census. The Bureau of the Census divided the Nation into

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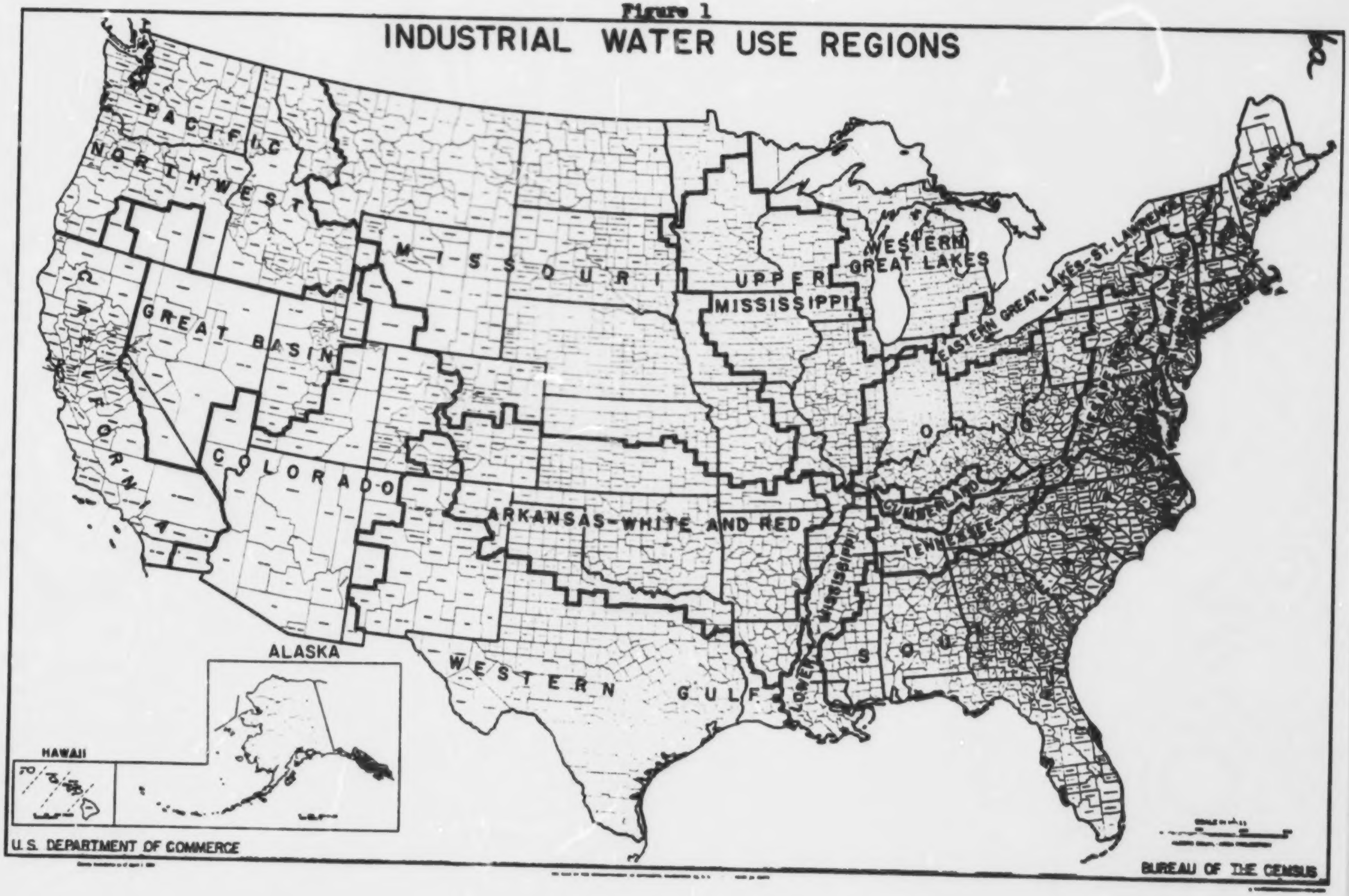
Figure 1

INDUSTRIAL WATER USE REGIONS



18 industrial water use regions for taking the census of industrial water use. These regions are shown in Figure 1. The industrial water use regions established by the Bureau of the Census, however, do not conform in all cases to the regions established by the Public Health Service for comprehensive studies of water pollution control. This fact should be taken into consideration when using the data compiled from Bureau of the Census reports.

Statistics were developed from U. S. Census data to reflect average water use per unit of production for as many of the four-digit industries as available data would permit. The data represent water use in all plants (modern and obsolete) using various manufacturing processes. Therefore, quantities of water used by various industries, as developed from the data in the census reports, may be on the high side, for projection purposes, because more modern plants and new processes (such as the oxygen process for making steel) may have a lower water use requirement than the more obsolete plants and processes. This, however, requires more research and study to determine the affects of new processes on water use requirements. It can safely be assumed, however, that at any given point in time there will always be plants engaged in a given type of production that will use more water than others because of outdated processes, poor water management, or for other reasons.

While industrial processes affect the consumption pattern of water intake, differing climate, water management practices, and institutional variations also affect the use and reuse of water. An examination of the statistics developed from census data shows a significant variation in water use and in recirculation ratios in specific manufacturing industries between regions. These differences may be due to climate, industrial processes, water management practices, or institutional variations. A knowledge of the relationships of water intake and water management to industrial activity is frequently needed to gauge present industrial water requirements. An understanding of these relationships is also required for making projections of industrial water use.

To facilitate the application of the data to local or regional projects, the statistics developed from census data show, for significant water users, total water intake and gross water use per employee and per dollar value added by manufacture, amount of intake water used for process and cooling per employee, and total water discharged per employee.

Trends in Industrial Water Use

Water in Industry, a report by the National Association of Manufacturers and the Conservation Foundation, New York, 1950, gives some information on trends in industrial water use for the period 1939-1949. This report presents the results of a survey covering 3,057 industrial plants using a total of eight billion gallons of water per day.

The report shows that 5.4 percent of the plants surveyed used an average of more than 10 million gallons daily and accounted for 78.2 percent of total water intake; 11.5 percent used an average of one to 10 million gallons per day and accounted for 17.4 percent of total water intake; 15.9 percent used an average of 250,000 to one million gallons daily, accounting for 3.3 percent of the intake; and 67.3 percent of the plants surveyed used an average of less than 250,000 gallons daily and accounted for only 1.2 percent of the total water intake.

Quoting from the report: "These facts strongly suggest that future studies of the industrial water problems can advantageously pay particular attention to the relatively few large water users. 5/ The myriads of small users draw, even in the aggregate, a much smaller share of the available water. This must have considerable significance in planning the use of our water resources.

"This leads naturally to the next questions: Who are the large water users? In what industries are they concentrated?

"....In the petroleum products industry classification, 57 percent of all the plants take in over a million gallons per day. In the paper and pulp industry, 43 percent of the plants likewise have an intake of more than a million gallons per day. None of the other industry classifications approached these percentages, the closest being the chemicals and drugs group and food industry group where 25 and 22 percent of the plants, respectively, use water in excess of one million gallons per day. 6/

"The electrical group, including power-generating stations and equipment manufacturers, contained a high proportion of plants using more than 10 million gallons daily, but a relatively low proportion using between one and 10 million

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5/ Underlining by the author of this paper.

6/ Since this report (NAM-CF) covers the period 1939-49, the industrial classification used is not the same as the Standard Industrial Classification as revised in 1957.

gallons. If these two classes are combined, only 18 percent of the plants in the electrical group use more than one million gallons daily, which is not an exceptionally high figure, compared with some of the other industries."

Table A shows the distribution of respondent plants according to change in water intake, 1939 to 1949.

Table A
Distribution of Respondent Plants
According to Change in Water Intake, 1939 to 1949 a/

Change in Water Intake 1939 to 1949	Number of plants	Percent of total	Cumulative percent
Decrease	284	12.5	12.5
No change	320	14.2	26.7
Increase:			
Up to 10 percent	96	4.3	31.0
10 to 20 "	149	6.6	37.6
20 to 30 "	184	8.2	45.8
30 to 40 "	160	7.1	52.9
40 to 50 "	95	4.2	57.1
50 to 75 "	246	10.9	68.0
75 to 100 "	108	4.8	72.8
100 to 200 "	347	15.4	88.2
Over 200 "	263	11.7	100.0
Total	2,252*	100.0	

*Excludes 1,091 respondent plants which did not supply this information. Many of these were plants which were not in existence in 1939. Thus, the table does not reflect an important factor in the growth of industrial water intake; i.e., the water intake of plants constructed since 1939.

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a/ Source: Water in Industry, National Association of Manufacturers-Conservation Foundation, New York, 1950.

"The above classification of the plants covered by the survey according to the change in their water intake, 1939 to 1949, reveals a wide variation in their experience. One out of eight of them reported an actual decline in water intake, and another 14 percent reported no change. Although three-quarters of the plants indicated that their water intake had increased over the decade, the extent of the increases differed widely. There were even 263 plants which reported more than a 200 percent increase. The overall conclusion is that, while the increase in industrial production since 1939 has entailed a greater use of water, the experience of individual enterprises has varied over a wide range.

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"The column of cumulative percentages in the foregoing table is also highly informative. Almost a third of the cases showed changes below a 10 percent increase. Slightly more than half were below a 40 percent increase. However, the cumulative percentage up to a 100 percent increase was only 72.8 percent, leaving more than a quarter of the cases with a percentage increase exceeding 100 percent.

"The question arises as to whether these differences of trend among the plants are systematic as between different industries. In other words, do specific industries show their own peculiar patterns of increase over the period 1939 to 1949, or do they merely reflect the general pattern described above?" Table B shows the average percent increase in water intake by various industries.

".... The average increase from 1939 to 1949 in water intake, for all the plants covered in the survey, was 36 percent. This does not mean that total industrial water intake in the Nation grew at this rate since this average cannot, by its nature, include the intake by new plants established between 1939 and 1949. The 36 percent figure applies to the experience of plants in continuous existence over the decade.

"The fact that the average plant increased its water intake by 36 percent over the decade does not tell the whole story. It raises the corollary question of whether this increase is due merely to a stepping up of the scale of industrial operations or whether it represents a change in industrial water practices. Some light is thrown on this question if the 'scale of operations' is measured in terms of employees, and the increase in this factor, 1939 to 1949, is compared with the increase in water use.

"In the first place, the average percent increase in number of employees for all the reporting plants is 33 percent. If necessary allowance is made for the margin for error in the figures, this is not significantly different from the 36 percent average increase in water intake. Thus, in general, the water use per plant increased in about the same proportion, from 1939 to 1949, as the 'scale of operations', measured by the number of employees on the payroll.

"But a deeper question is involved which is not answered by a comparison of the two overall averages. Are the differences among the plants with respect to the change in their water intake explainable by differences in the growth of their

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Table B
Average Percent Increase in Water Intake a/
1939 to 1949

Industry*	Number of Plants Included in Average	Average Percent Increase
Apparel and textiles	195	21
Auto and aircraft	73	82
Chemical and drugs	154	45
Electrical (power generation and equip. mfg.)	197	51
Foods, beverages and tobacco	280	38
Iron and steel	267	45
Leather	34	7
Lumber and furniture	101	0
Machinery and tools	374	52
Nonferrous metals	97	29
Medical and scientific supplies	33	73
Paper and pulp	137	20
Petroleum	45	58
Plastics	17	32
Stone and glass	154	29
Toys, etc.	11	38
Miscellaneous	183	37
All plants, combined	2,252	36

*Based on old Standard Industrial Classification

a/ Source: Water in Industry, National Association of Manufacturers-Conservation Foundation, New York, 1950.

number of employees? In other words, do the plants which show exceptionally high increases in water intake also show exceptionally high rates of growth in the number of employees and vice versa?

"One way of answering this question is to classify the respondent plants according to the percentage change in the water intake, 1939 to 1949, and then determine, for each of the classes, the average percent change in the number of employees. When this is done an interesting result emerges."

The classification of plants according to percent change in water intake and average percent change in employment in each class, 1939 to 1949, is shown in Table C.

Table C
Plants Reporting Change in Water Intake Classified According to Percent Change in Water Intake, 1939 to 1949, Showing the Average Percent Change in Employment In Each Class a/

Change in Water Intake (1939 to 1949)		Number of Plants	Median Percent Change in Employment (1939 to 1949)	
Decrease:				
75-100	percent	13	0	percent
50-74	"	31	+5	"
40-49	"	16	-2	"
30-39	"	40	0	"
20-29	"	57	0	"
10-19	"	61	0	"
1-19	"	55	+3	"
No Change		306	0	"
Increase:				
1-9	"	94	18	"
10-19	"	142	20	"
20-29	"	180	27	"
30-39	"	159	27	"
40-49	"	95	34	"
50-74	"	241	46	"
75-99	"	106	60	"
100-199	"	344	64	"
200 & over	"	259	134	"
All plants, combined		2,205	+33	"

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a/ Source: Water in Industry, National Association of Manufacturers-Conservation Foundation, New York, 1950.

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"The plants which reported an actual decrease in their water use, experienced, on the average, practically no change in the number of employees. This appears to be as true for the plants which reported a very great decrease in water use as for those which reported only a slight decrease.

"About 300 plants did not have any change whatever in their water intake. On the average, these same plants had no change in the scale of their operations (in terms of employees) over the decade. This does not mean that none of the 300 plants reported any change in employment, but merely that the average of their increases and decreases turned out zero.

"Among the plants which did increase their water intake, there is a clear tendency for the larger increases in water intake to be associated with larger increases in employment. The 94 plants which increased water intake by less than 10 percent, increased their employees by (on the average) 18 percent. The 259 plants which reported increases in water intake of more than 200 percent increased the number of their employees by (on the average) 134 percent.

"The conclusion is that there is a pronounced, albeit imperfect, relationship between the change in water intake and the change in number of employees. The recent increase in industrial water use is to be accounted for largely in terms of the stepping-up of industrial operations, although there are apparently other factors also at work.

"An interesting result emerges from this survey data if the comparison is made of the growth in water use, by the size of the plants. The small plants, with less than 100 employees, increased their intake by only 27 percent on the average. The plants with more than 2,500 employees increased their intake at nearly twice that rate. There is a clear tendency for the rate of growth in water use to increase systematically with the size of the plant."

The increases in water intake by size of plant are shown in Table D.

Censuses of industrial water use were taken by the Bureau of the Census in 1954 and 1958. Because of changes in the Standard Industrial Classification made in 1957, however, the data from the two census years are not directly comparable.

Data pertaining to quantity of water used and discharged by manufacturing establishments, by purpose of industrial use for two-digit industry groups and for selected four-digit industries for 1954 and 1958 are presented in Table E of the

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Table D
Increase in Intake, 1939 to 1949, by Size of Plant a/

Number of employees (in 1949)	Average* percent increase in intake 1939 to 1949	Number of plants on which average is based
Less than 100	27%	638
101 to 250	31	540
251 to 500	39	404
501 to 1,000	42	338
1,001 to 2,500	50	207
Over 2,500	52	106
All plants combined	36	2,252**

* The Average used here is a median; i.e., the percentage such that an equal number of cases fall above and below it.

** Includes 19 plants for which information on number of employees was not furnished.

a/ Source: Water in Industry, National Association of Manufacturers-Conservation Foundation, New York, 1950.

(1) recirc. flow = $\overset{use}{1963} - \overset{intake}{917} = 1046$

recirc. ratio = $\frac{1046}{917}$ =

12-b

Table E

Comparison of Industrial Water Use Per Year
by Specified Industries
1954-1959 1/

SIC	Industry	Water Intake per Employee (1000 gal.)		Gross Water Use per Employee (1000 gal.)		Total Water Discharged per Employee (1000 gal.)		Recirculation Ratio	
		1954 a/	1959	1954 a/	1959	1954 a/	1959	(1) 1954 a/	1959
20	Food and kindred products	917	915	1,963	1,950	819	843	1.14	1.13
2011	Meat packing plants	567	582	967	1,141	474	536	0.70	0.96
2013	Prepared meats	606	287	943	430	404	143	0.56	0.50
2024	Ice cream and frozen desserts	697	504	1,161	1,008	581	504	0.66	1.00
2034	Dehydrated fruits & vegetables	534	759	-	1,266	534	759	-	0.67
2036	Fluid milk	531	287	1,063	574	531	287	1.00	1.00
2041	Flour and meal	1,652	302	2,103	302	1,352	151	0.27	0.00
2042	Prepared animal feeds	868	584	1,446	584	868	584	0.66	0.00
2043	Cereal preparations	532	406	532	508	399	406	0.00	0.25
2046	Wet corn milling	2,619	3,454	3,543	4,740	2,388	3,133	0.35	0.37
2061	Raw cane sugar	6,847	11,108	7,568	19,359	2,523	9,679	0.10	0.74
2062	Cane sugar refining	3,301	4,221	3,697	4,757	3,235	4,020	0.12	0.13

See footnotes at end of table.

Table E

Comparison of Industrial Water Use Per Year
by Specified Industries
1954-1959 1/

SIC	Industry	Water Intake per Employee (1000 gal.)		Gross Water Use per Employee (1000 gal.)		Total Water Discharged per Employee (1000 gal.)		Recirculation Ratio	
		1954 a/	1959	1954 a/	1959	1954 a/	1959	1954 a/	1959
2063	Beet sugar	3,705	4,716	4,876	7,860	3,705	4,421	0.32	0.67
2082	Malt liquors	713	781	5,380	1,351	611	700	6.54	0.73
2083	Malt	6,092	3,356	6,092	6,040	5,623	3,356	0.00	0.80
2084	Wines and brandy	2,039	925	2,039	925	1,019	925	0.00	0.00
2085	Distilled liquor, except brandy	992	1,762	1,458	2,477	875	1,597	0.47	0.40
2092	Soybean oil mills	1,845	2,182	5,535	5,333	1,640	1,939	2.00	1.44
2093	Vegetable oil mills	3,666	2,281	6,416	4,563	3,666	2,281	0.75	1.00
2094	Grease and tallow	2,679	1,786	3,897	2,679	2,435	1,786	0.45	0.50
22	Textile mill products	406	363	465	490	326	324	0.14	0.35
2231	Weaving and finishing mills, wool	821	560	930	784	575	485	0.13	0.40
2262	Finishing plants, synthetics	-	991	-	991	-	793	-	0.00
2297	Scouring and combing plants, wool	649	767	649	767	433	767	0.00	0.00

See footnotes at end of table.

12-d

Table E

Comparison of Industrial Water Use Per Year
by Specified Industries
1954-1959 1/

SIC	Industry	Water Intake per Employee (1000 gal.)		Gross Water Use per Employee (1000 gal.)		Total Water Discharged per Employee (1000 gal.)		Recirculation Ratio	
		1954 a/	1959	1954 a/	1959	1954 a/	1959	1954 a/	1959
24	Lumber and wood products	1,571	1,198	1,890	1,574	1,287	1,078	0.20	0.31
2432	Veneer and plywood plants	860	727	1,003	895	860	615	0.17	0.23
26	Paper and allied products	7,115	6,822	16,900	21,418	6,454	6,431	1.37	2.14
2641	Paper coating and glazing	1,348	1,069	1,888	3,208	1,281	998	0.40	2.00
2646	Pressed and molded pulp goods	1,127	1,359	2,254	2,039	1,127	1,359	1.00	0.50
28	Chemical & allied prods.	6,012	7,616	9,613	12,242	5,710	7,198	0.60	0.61
2812	Alkalies and chlorine	22,726	25,777	24,864	28,774	22,378	23,878	0.09	0.12
2814	Cyclic (coal tar) crudes	9,886	2,044	9,886	2,725	9,125	2,044	0.00	0.33
2815	Intermediate coal tar prod.	4,882	5,625	6,712	9,948	4,595	5,457	0.37	0.77
2816	Inorganic pigments	4,085	7,215	5,579	9,019	3,886	6,814	0.36	0.25
2821	Plastics materials	1,913	2,809	3,473	6,576	1,825	2,580	0.81	1.34
2822	Synthetic rubber	4,336	4,501	15,767	11,844	4,073	4,145	2.64	1.63
2834	Pharmaceutical preparations	450	421	983	1,026	410	385	1.18	1.44

See footnotes at end of table.

Table E

Comparison of Industrial Water Use Per Year by Specified Industries 1954 - 1959 1/

SIC	Industry	Water Intake per Employee (1000 gal.)		Gross Water Use per Employee (1000 gal.)		Total Water Discharged per Employee (1000 gal.)		Recirculation Ratio	
		1954 a/	1959	1954 a/	1959	1954 a/	1959	1954 a/	1959
2871	Fertilizers	3,762	4,849	4,554	8,122	3,267	4,000	0.21	0.67
2892	Explosives	1,583	1,355	2,012	1,807	1,517	1,265	0.27	0.33
2894	Fatty acids	3,417	1,586	7,403	6,344	2,847	1,586	1.17	3.00
29	Petroleum and coal products	8,033	9,376	26,791	40,936	7,317	8,562	2.33	3.37
2911	Petroleum refining	8,534	9,727	28,675	42,790	7,773	8,896	2.36	3.40
2952	Asphalt felts and coatings	2,434	1,406	6,449	1,933	2,190	703	1.65	0.37
30	Rubber and plastics products	623	622	999	1,629	590	582	0.60	1.62
3011	Tires and inner tubes	779	758	1,366	1,439	767	703	0.75	0.90
3031	Reclaimed rubber	1,380	1,948	2,300	2,435	1,380	1,948	0.67	0.25
3111	Leather tanning and finishing	702	654	773	709	632	600	0.10	0.08
32	Stone, clay, and glass products	1,348	1,279	2,778	2,876	1,227	1,155	1.06	1.25
3211	Flat glass	1,247	1,550	2,254	2,815	1,151	1,550	0.81	0.82
3221	Glass containers	190	181	408	747	190	158	1.15	3.12
3251	Structural clay products	1,862	1,805	5,587	1,805	1,862	1,805	2.00	0.00

See footnotes at end of table.

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Table E

Comparison of Industrial Water Use Per Year
by Specified Industries
1954 - 1959 1/

SIC	Industry	Water Intake per Employee (1000 gal.)		Gross Water Use per Employee (1000 gal.)		Total Water Discharged per Employee (1000 gal.)		Recirculation Ratio	
		1954 a/	1959	1954 a/	1959	1954 a/	1959	1954 a/	1959
3275	Gypsum products	964	808	1,652	942	964	673	0.71	0.16
3281	Cut stone and stone products	624	1,006	1,871	1,006	624	1,006	2.00	0.00
3293	Gaskets and insulations	191	953	574	1,906	191	635	2.00	1.00
33	Primary metals industries	4,215	4,198	5,427	6,365	4,039	4,037	0.29	0.52
3312	Blast furnaces and steel mills	5,863	6,031	7,572	9,207	5,636	5,793	0.29	0.53
3313	Electrometallurgical products	17,223	21,195	19,072	22,962	17,126	21,103	0.11	0.08
3317	Steel pipe and tubes	575	500	719	714	575	500	0.25	0.43
3321	Gray iron foundries	560	488	714	670	521	447	0.27	0.37
3322	Malleable iron foundries	526	706	658	1,060	526	565	0.25	0.50
3331	Primary copper	3,587	4,115	6,490	13,134	3,330	3,152	0.81	2.19
3332	Primary lead	2,041	1,601	3,061	2,802	1,786	1,201	0.50	0.75
3333	Primary zinc	1,899	5,236	2,954	9,451	1,688	4,981	0.56	0.80
3334	Primary aluminum	7,760	11,929	11,398	20,555	7,615	11,592	0.47	0.72
3341	Secondary nonferrous metals	395	1,077	592	1,346	395	808	0.50	0.25
3717	Motor vehicles and parts	156	242	266	574	148	228	0.71	1.37

1/ Source: 1959 Census of Manufactures - Industrial Water Use. Bureau of the Census, U.S. Dept. of Commerce

a/ Retabulated (by Bureau of the Census) to conform with the Standard Industrial Classification Manual issued in 1957.

All Data are U.S. averages.

1959 census report on industrial water use. Again, these statistics relate to establishments using 20 million gallons or more of water per year. The 1954 data presented in Table 2 in the 1959 census report were retabulated by the Bureau of the Census to make it conform with the Standard Industrial Classification Manual issued in 1957. Therefore, it is possible to make some direct comparisons in industrial water use between the two census years. These comparisons as presented in Table E, however, must be used with extreme care and discretion when used as guides to changes in industrial water use through time.

Projections of Industrial Water Use

Projections of industrial water use are probably the most difficult part of the industrial water study. It is impossible to foresee, even in the short run, what technological developments will occur in the industrial water use field, and little is known at the present time about industrial sensitivity to water costs; or to put it in economic terms, the price elasticity of demand for water. It is generally agreed that with an increasing scarcity of water of acceptable quality to meet industrial needs in the future, cost of water to the user will increase. These increased costs can be expected to result from more costly impoundments to meet supply needs and from increased treatment as water quality degrades. The best that can be done at the present is to base the water supply and pollution control study on static assumptions and later to relax those assumptions through the development of factors that will reflect a dynamic situation.

Industrial water use projections must necessarily be directly correlated with projected industrial activity and, therefore, must tie to the economic projections. A number of different indicators may be used, either singly or collectively, in making projections of industrial activity. The projections may be based on employment in manufacturing industries, or they may be based on value added by manufacture as a measure of industrial productivity. These are the most commonly used indicators, primarily because adequate data are more or less readily available. Other indicators sometimes used in making projections of industrial activity are income generated by industry, projected demands for industrial products on a national or regional basis, and trends in expenditures for industrial expansion and growth.

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TABLE F

INDEXES OF OUTPUT PER MAN-HOUR-
PRODUCTION WORKERS, SELECTED INDUSTRIES: 1939 to 1961*

Industry	1939	1940	1945	1947	1950	1955	1957	1958	1959	1960	1961
Blast furnace and basic steel products	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	98.7	96.5	105.1	100.2	105.1
Beet-sugar refining	65.8	68.5	52.3	61.2	75.4	n.a.	n.a.	98.1	103.9	106.9	103.4
Fruit & vegetable canning & preserving	55.5	61.2	63.2	61.7	75.7	89.4	98.4	98.2	103.5	106.0	n.a.
Cement	51.6	54.7	49.2	60.8	70.5	91.6	92.4	99.7	108.3	102.8	n.a.
Clay construction products	71.6	n.a.	n.a.	76.0	87.3	103.2	99.4	99.8	n.a.	n.a.	n.a.
Flour & other grain mill products	78.0	79.5	70.6	71.3	69.7	86.8	99.2	102.7	98.2	104.0	107.4
Glass containers	73.3	72.7	86.7	94.9	95.1	99.7	99.8	97.3	102.9	100.6	102.7
Malt liquors	55.3	56.7	66.0	64.7	77.8	87.2	93.1	102.1	105.5	108.3	113.3
Paper and pulp	71.8	75.6	62.8	65.8	78.4	90.4	96.1	98.8	104.9	109.3	n.a.
Petroleum refining	55.9	57.8	48.6	53.5	68.3	87.8	93.2	98.1	109.7	114.1	121.9
Synthetic fibers	n.a.	18.1	27.8	n.a.	51.9	77.3	93.0	96.2	110.4	114.6	n.a.
Tires and inner tubes	n.a.	n.a.	n.a.	67.8	82.7	86.2	93.8	99.0	107.4	112.1	118.0
Primary smelting and refining of copper, lead, and zinc.	62.9	69.2	60.9	64.1	77.8	96.8	99.3	100.8	100.0	101.2	n.a.

*Source: Statistical Abstract of the United States, U. S. Bureau of the Census, Washington, D. C., 1963, p. 238 and 1964, p. 236.

TABLE G

INDUSTRIAL PRODUCTION - INDEXES, BY INDUSTRY: 1950-1963

1957-59 equals 100. Based on 1957 Standard Industrial Classification*

Industry	1950	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Total industry	75	84	91	86	97	100	101	94	106	109	110	118	124
Total manufacturing	76	89	93	86	97	100	101	93	106	109	110	119	125
Total durable manufactures	74	89	100	88	102	104	104	90	106	109	107	118	124
Primary metals	100	99	113	91	118	116	112	88	100	101	99	105	113
Fabricated metal products	85	89	100	90	98	99	102	93	106	108	107	117	123
Machinery	73	92	101	88	97	107	104	89	107	111	110	124	129
Transportation equipment	56	73	92	84	102	97	106	90	104	108	104	118	127
Instruments and related products	57	78	85	83	89	95	98	92	110	117	116	123	130
Stone, clay, and glass products	81	85	87	84	96	100	98	93	108	108	106	111	118
Lumber and wood products	98	97	102	100	110	105	96	96	109	102	101	106	109
Furniture and fixtures	79	77	80	84	95	98	97	93	111	116	115	127	133
Miscellaneous manufactures	89	88	99	90	101	104	99	94	107	111	113	122	125
Total nondurable manufactures	76	80	84	84	92	95	97	97	107	110	113	120	125
Textile mill products	96	94	96	90	99	100	97	94	109	105	107	115	117
Apparel products	82	85	87	84	92	96	97	95	108	112	112	119	126
Leather and leather products	91	91	91	90	98	100	99	96	105	100	100	102	100
Paper and allied products	74	75	81	82	93	97	96	97	107	108	114	120	125
Printing and publishing	79	80	84	87	93	97	99	97	104	110	112	115	116
Chemicals and allied products	55	66	71	71	83	89	94	96	110	117	123	136	149
Petroleum products	73	83	88	88	94	99	99	97	104	107	109	113	117
Rubber and plastics products	70	73	78	77	95	93	97	92	111	111	112	131	139
Food and kindred products	83	87	88	90	94	97	97	99	104	107	110	114	116
Tobacco products	84	92	90	86	88	91	94	100	105	107	111	112	115
Total mining	83	91	93	90	99	105	105	96	100	102	103	105	108
Total utilities	50	61	67	72	80	88	94	98	108	116	123	131	141

Source: Board of Governors of the Federal Reserve System; Industrial Production, 1957-59 Base, and Federal Reserve Bulletin.

Source: Statistical Abstract of the United States, U. S. Bureau of the Census, 1964. (58th Ed.) Washington, D. C., 1964, p. 771.

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Projections based on employment must necessarily take into consideration productivity indexes of output per worker. Although no projections of productivity indexes of output are available at the present time, Table F shows productivity indexes of output per worker for specified products and for specified years from 1939 to 1961. Table G shows industrial production indexes by industry, 1950 to 1963. These indexes may be useful guides in making projections of output per employee and industrial productivity when developing projections of industrial water use. Any projections made of industrial water use will have to be adjusted by engineering judgment to reflect anticipated changes in costs of water use or in changes in technology, or both. This will require close teamwork between engineers and economists. Factors to be taken into consideration in water use forecasting are presented in Part 6-2 of the manual.

Use of the Tables

In the following tables, water intake pertains to total intake water by the industry from all sources used. Gross water used is the total quantity of water which would have been needed if no water was recirculated or reused. The ratio of gross water use to water intake gives the in-plant recirculation rate. Water discharged is the quantity of water brought to the ultimate discharge point. The data exclude quantities of water held in ponds, lagoons, or basins, for reuse or treatment, or water discharged by evaporation processes. The data presented in the tables should not be applied without discretion to local situations. They have been computed from census data, based on broad U. S. averages or regional averages, and should be viewed only as guides to estimating industrial water use requirements. They should be used primarily as aides to judgment. Water use data obtained directly from industries may be much more accurate and therefore more applicable, especially in a given local area.

Table 1 shows industrial water requirements per employee and per dollar value added by manufacture, based on U. S. averages, by two-digit and four-digit industry category. Table 2 shows industrial water requirements, based on U. S. averages, by unit of product, for four-digit industries. Table 3 gives information on water intake and gross water use per employee and per dollar value added by manufacture amount of intake water used for process and cooling and amount of water discharged per employee by two-digit and specified four-digit industries by regions. Table 4 presents data on water use by water use regions by two-digit industry category (also for as many four-digit industries as available data permitted tabulation). Table 5 compares industrial water use as computed from census data with estimates made by the Senate Select Committee. Table 6 presents industrial water requirements for specified products as reported in several available references.

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Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S. Averages 1/ 1959

SIC	Industry	Water Intake per Employee (1000 gal)	Water Intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	915	69	1,950	147	13,272	252	493	843
2011	Meat packing plants 2/	582	62	1,141	121	9,415	260	207	536
2013	Prepared meats 3/	287	22	430	33	13,045	143	a/	143
2015	Poultry dressing plants	422	83	590	117	5,060	253	84	337
2021	Creamery butter	1,724	200	2,299	267	8,621	a/	1,150	1,724
2023	Condensed and evaporated milk	1,958	137	2,314	162	14,240	178	1,424	1,780
2024	Ice cream and frozen desserts	504	23	1,008	47	21,673	a/	168	504
2026	Fluid milk	356	32	562	50	11,218	75	169	318
2033	Canned fruits & vegetables	552	58	759	79	9,572	310	155	483
2034	Dehydrated fruits and vegetables	759	73	1,266	122	10,380	759	a/	759
2035	Pickles and sauces	579	51	724	64	11,296	145	434	579
2036	Fresh or frozen packaged fish	287	50	287	50	5,742	287	287	287
2041	Flour and meal	302	24	302	24	12,685	151	a/	151

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S. Averages 1/ 1959

SIC	Industry	Water intake per employee	Water intake per dollar value added	Gross water use per employee	Gross water use per dollar value added	Value added per employee	Process water per employee	Cooling water per employee	Water discharged per employee
		(1000 gal)	(gal)	(1000 gal)	(gal)	(dollars)	(1000 gal)	(1000 gal)	(1000 gal)
2042	Prepared animal feeds	584	24	584	24	23,963	292	292	584
2043	Cereal preparations	406	18	508	22	23,168	203	102	406
2046	Wet corn milling	3,454	173	4,740	237	20,003	321	2,410	3,133
2061	Raw cane sugar	11,108	1,045	19,359	1,821	10,632	2,222	5,078	9,679
2062	Cane sugar refining	4,221	350	4,757	394	12,060	268	3,685	4,020
2063	Beet sugar	4,716	366	7,860	611	12,871	2,456	1,769	4,421
2082	Malt liquors	781	45	1,351	77	17,429	179	228	700
2083	Malt	3,356	167	6,040	300	20,134	2,013	1,342	3,356
2084	Wines and brandy	925	34	925	34	26,827	a/	925	925
2085	Distilled liquor, except brandy	1,762	73	2,477	102	24,169	110	1,486	1,597
2086	Bottled and canned soft drinks	220	20	275	25	11,120	110	a/	165
2092	Soybean oil mills	2,182	111	5,333	272	19,636	242	1,697	1,939
2093	Vegetable oil mills	2,281	120	4,563	240	19,011	a/	2,281	2,281
2094	Grease and tallow	1,786	154	2,679	231	11,607	a/	1,339	1,786

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S. Averages 1959

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
22	Textile mill products	363	54	490	73	6,674	240	32	326
2231	Weaving & finishing mills, cotton	560	77	784	107	7,317	448	a/	485
2261	Finishing plants, cotton	1,327	211	1,587	252	6,297	1,015	26	1,171
2262	Finishing plants, synthetics	991	125	991	125	7,930	793	a/	793
2297	Scouring & combing plants, wool	767	143	767	143	5,368	383	a/	767
24	Lumber and wood products	1,198	159	1,574	209	7,537	231	94	1,078
2432	Veneer and plywood plants	727	94	895	116	7,716	56	168	615
26	Paper & allied products	6,822	503	21,418	1,578	13,573	4,043	618	6,431
2611	Pulp mills	18,847	1,290	55,622	3,807	14,611	14,964	988	18,564
2621	Paper mills, except building	8,459	620	26,108	1,914	13,641	5,399	513	7,947
2641	Paper coating & glazing	1,069	72	3,208	216	14,826	499	214	998
2646	Pressed & molded pulp goods	1,359	114	2,039	171	11,893	1,019	a/	1,359
2651	Folding & paperboard boxes	851	83	16,305	1,597	10,208	567	a/	851

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S. Averages 1/ 1959

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2653	Corrugated shipping containers	740	78	888	94	9,470	592	a/	740
2661	Building paper & board mills	3,104	262	6,773	571	11,852	2,314	169	2,766
28	Chemicals & allied prods.	7,616	333	12,242	535	22,879	1,011	5,051	7,198
2812	Alkalies & chlorine	25,777	1,491	28,774	1,665	17,284	849	17,234	23,878
2813	Industrial gases	27,380	1,158	33,914	1,434	23,647	311	24,891	24,580
2814	Cyclic (coal tar) crudes	2,044	120	2,725	160	17,030	a/	1,362	2,044
2815	Intermediate coal tar products	5,625	307	9,948	544	18,302	378	4,869	5,457
2816	Inorganic pigments	7,215	291	9,019	364	24,752	1,203	4,509	6,814
2821	Plastics materials	2,809	131	6,576	306	21,465	343	2,078	2,580
2822	Synthetic rubber	4,501	156	11,844	412	28,781	711	3,316	4.145
2823	Cellulosic man-made fibers 4/	4,309	402	8,642	806	10,723	726	2,687	4,309
2824	Organic fibers, noncellulosic	3,007	119	4,648	184	25,243	137	1,458	2,324

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S Averages 1/ 1959

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2834	Pharmaceutical preparations	421	15	1,026	38	27,323	37	330	385
2841	Soap & other detergents	1,310	32	4,311	107	40,330	55	1,091	1,201
2842	Polishes & sanitation goods	1,546	38	2,061	51	40,701	515	515	515
2843	Surface active agents	2,364	50	4,728	100	47,281	a/	a/	2,364
285	Paints & varnishes	570	29	855	43	19,802	71	427	499
286	Gum & wood chemicals	6,515	459	10,730	757	14,179	958	4,599	5,748
2871	Fertilizers	4,849	385	8,122	644	12,608	1,576	2,546	4,000
2873	Agricultural pesticides	1,406	44	4,923	156	31,646	a/	703	703
2891	Glue and gelatin	3,371	173	4,494	231	19,476	1,873	1,124	2,622
2892	Explosives	1,355	125	1,807	167	10,839	271	723	1,265
2894	Fatty acids	1,586	87	6,344	348	18,239	a/	793	1,586
2895	Carbon black	1,187	44	2,374	89	26,706	1,187	a/	a/

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per day
U. S. Averages 1/ 1959

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
29	Petroleum & coal products	9,376	532	40,936	2,325	17,610	628	7,842	8,562
2911	Petroleum refining	9,727	548	42,790	2,411	17,748	631	8,169	8,896
2952	Asphalt felts and coatings	1,406	114	1,933	157	12,300	703	351	703
30	Rubber and plastics products	622	56	1,629	147	11,087	106	303	582
3011	Tires & inner tubes	758	54	1,439	103	13,949	143	242	703
3031	Reclaimed rubber	1,948	174	2,435	217	11,203	a/	1,948	1,948
3111	Leather tanning and finishing	654	78	709	85	8,344	545	55	600
32	Stone, clay, and glass products	1,279	97	2,876	218	13,217	274	230	1,155
3211	Flat glass	1,550	102	2,815	185	15,216	408	326	1,550
3221	Glass containers	181	17	747	69	10,868	23	91	158
3251	Structural clay products	1,805	500	1,805	500	3,610	a/	a/	1,805

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S. Averages 1/ 1959

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
3273	Ready-mixed concrete	1,385	125	1,385	125	11,080	1,385	a/	1,385
3275	Gypsum products	808	41	942	48	19,521	269	135	673
3281	Cut stone & stone prods.	1,006	167	1,006	167	6,038	1,006	a/	1,006
3293	Gaskets and insulations	953	136	1,906	273	6,989	318	a/	635
3295	Minerals; ground or treated	9,973	647	13,599	882	15,413	9,066	907	9,973
3296	Mineral wool	968	76	1,936	152	12,723	138	553	830
3297	Nonclay refractories	2,925	175	2,925	175	16,715	2,925	a/	2,925
33	Primary metal industries	4,198	336	6,365	510	12,479	1,024	1,781	4,037
3312	Blast furnaces and steel mills	6,031	457	9,207	698	13,198	1,547	2,685	5,793
3313	Electrometallurgical products	21,195	1,520	22,962	1,647	13,944	279	5,950	21,103
3316	Cold finishing of steel shapes	825	50	962	58	16,497	275	550	825

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S. Averages 1/ 1959

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
3317	Steel pipe and tubes	500	33	714	47	15,215	357	71	500
3321	Gray iron foundries	488	52	670	72	9,345	223	203	447
3322	Malleable iron foundries	706	90	1,060	135	7,841	141	424	565
3331	Primary copper	4,115	495	13,134	1,579	8,318	1,751	1,313	3,152
3332	Primary lead	1,601	160	2,802	280	10,008	400	801	1,201
3333	Primary zinc	5,236	554	9,451	10,000	9,451	383	1,788	4,981
3334	Primary aluminum	11,929	434	20,555	748	27,497	674	674	11,592
3341	Secondary nonferrous metals	1,077	182	1,346	227	5,924	269	538	808
3351	Copper rolling and drawing	842	65	1,178	90	13,044	449	224	842
3352	Aluminum rolling and drawing	866	72	1,641	136	12,083	296	388	798

See footnotes at end of table.

Table 1

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year
U. S. Averages 1/ 1959

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
35	Machinery, except electrical	337	31	493	45	10,856	30	110	327
3511	Steam engines and turbines	2,508	204	2,704	220	12,313	65	1,042	2,508
3522	Farm machinery and equipment	592	50	758	65	11,741	45	61	592
3717	Motor vehicles and parts	242	16	574	38	15,001	62	48	228

1/ Computed from data given in 1959 Census of Manufactures-Industrial Water Use Bureau of the Census, 1959.

a/ No figure given in census data where total use in industry is less than 500 million gallons.

2/ Dressed weight-carcasses and slaughter house products.

3/ Sausages and other prepared meats. Primarily manufacture of sausages, cured meats, smoked meats, canned meats, frozen meats, other prepared meats, and meat specialties, from purchased carcasses and other materials.

4/ Primarily manufacture of cellulosic fibers (including cellulose acetate and regenerated cellulose such as rayon by the viscose or cuprammonium process) in the form of monofilament, yarn, staple or tow suitable for further manufacturing on spindles, looms, knitting machines or other textile processing equipment.

Table 2
Production and Water Use per Unit of Product in Industrial Plants Using 20 Million Gallons or More per Year
U. S. Averages 1/ 1959

SIC	Industry	Unit of production	Production units per employee	Gallons of water per unit of production				
				Water intake	Gross water use	Process water	Cooling water	Water discharged
2011	Meat packing plants 2/	1000 lbs	97.2 a/	5,990	11,700	2,675	2,130	5,515
2013	Prepared meats 3/	" "	137.7 a/	2,085	3,120	1,040	c/	1,040
2015	Poultry dressing plants	" "	78.0 a/	5,410	7,565	3,245	1,075	4,320
2021	Creamery butter	" "	78.6 a/	21,930	29,250	3,560	14,630	21,930
2023	Condensed & evaporated milk	" "	488.5 a/	4,010	4,735	365	2,915	3,645
2024	Ice cream & frozen desserts	1000 gals.	53.0 a/	9,510	19,020	1,585	3,170	9,510
2026	Fluid milk	1000 lbs.	78.5 a/	4,535	7,160	955	2,150	4,050
2033	Canned fruits & vegetables	1000 cases	4.1 b/	134,600	185,100	75,600	37,800	117,800
2035	Pickles and sauces	1000 gals.	25.8 b/	22,440	28,060	5,620	16,820	22,440
2036	Fresh or frozen packaged fish	1000 lbs.	32.3 b/	8,885	8,885	8,885	8,885	8,885
2037	Frozen fruits & vegetables	" "	74.4 b/	21,140	32,875	6,465	12,915	20,550
2041= 2045	Flour and meal	1000 sacks (cwt)	14.5 b/	20,830	20,830	10,415	5,170	10,415
2042	Prepared animal feeds	1000 tons	29.1 b/	20,070	20,070	10,035	10,035	20,070
2043	Cereal preparations	1000 lbs.	151.5 b/	2,680	3,355	1,340	675	2,680

See footnotes at end of table.

Table 2
Production and Water Use per Unit of Product in Industrial Plants Using 20 Million Gallons or More per Year
U. S. Averages 1/ 1959

SIC	Industry	Unit of production	Production units per employee	Gallons of water per unit of production				
				Water intake	Gross water use	Process water	Cooling water	Water discharged
2046	Wet corn milling	1000 lbs.	161.7 b/	21,360	29,315	1,985	14,905	19,375
2061	Raw cane sugar	Short tons	147.2 b/	75,500	131,500	15,100	34,500	65,755
2062	Cane sugar refining	" "	379.2 b/	11,130	12,545	705	9,720	10,600
2063	Beet sugar	" "	209.4 b/	22,520	37,535	11,730	8,450	21,110
2082	Malt liquors	Barrel	1,200.0 a/	650	1,125	150	190	585
2083	Malt	1000 lbs.	1,251.4 a/	2,680	4,825	1,610	1,070	2,680
2084	Wines and brandy	1000 gals.	32.4 a/	28,550	28,550	3,860	21,450	28,550
2085	Distilled liquor (except brandy)	" "	18.2 a/	96,800	136,100	6,050	81,650	86,760
2086	Bottled & canned soft drinks	1000 cases	12.9 a/	17,050	21,320	8,530	5,425	12,800
2297	Wool scouring and combing	1000 lbs.	21.8 b/	35,185	35,185	17,570	3,945	35,185
2611	Pulp mills	Short tons	1,542.0 b/	12,220	36,070	9,700	640	12,040
2621	Paper mills, except building	" "	103.2 b/	82,000	253,000	52,300	4,970	83,300

See footnotes at end of table.

Table 2
Production and Water Use per Unit of Product in Industrial Plants Using 20 Million Gallons or More per Year
U. S. Averages 1/ 1959

				Gallons of water per unit of production				
SIC	Industry	Unit of production	Production units per employee	Water intake	Gross water use	Process water	Cooling water	Water discharged
2631	Paperboard mills	Short tons	247.7 b/	35,690	117,100	19,175	6,120	33,145
2661	Bldg. paper & board mills	" "	150.4 b/	20,640	45,035	15,385	1,125	18,390
2812	Alkalies & chlorine	" "	684.2 b/	37,675	42,055	1,240	25,190	34,900
2816	Inorganic pigments	" "	76.2 b/	94,690	118,360	15,780	59,180	89,425
2819	Inorganic chemicals nec 4/	" "	477.1 b/	18,300	42,470	2,680	11,020	16,890
2821	Plastics materials	1000 lbs.	114.6 b/	24,510	57,390	2,990	18,135	22,515
2822	Synthetic rubber	" "	273.4 b/	16,465	43,325	2,600	12,130	15,165
2823	Cellulosic man-made fibers	" "	37.5 b/	115,050	230,750	19,390	71,745	115,050
2851	Paints and varnishes	1000 gals.	10.0 b/	57,020	85,530	7,130	42,765	49,895
3241	Cement, hydraulic	Barrel of 376 lbs.	7,764.3 a/	630	1,075	50	105	565
3211	Flat glass	1000 sq. ft.	24.7 a/	62,750	113,965	16,520	13,200	62,750
3221	Glass containers	1000 gross	2.7 a/	67,035	276,665	8,520	33,705	58.520
3312	Blast furnaces & steel mills	Short tons	112.7 b/	53,500	81,700	13,700	23,800	51,400
3313	Electrometallurgical products	" "	138.5 b/	153,075 d/	165,830	2,015	42,970	152,400

See footnotes at end of table.

Table 2
Production and Water Use per Unit of Product in Industrial Plants Using 20 Million Gallons
or More per Year
U. S. Averages 1/ 1959

SIC	Industry	Unit of production	Production units per employee	Gallons of water per unit of production				
				Water intake	Gross water use	Process water	Cooling water	Water discharged
3322	Malleable iron foundries	Short tons	28.7 a/	24,590	36,890	4,918	14,755	19,675
3323	Steel foundries	" "	18.7 a/	13,820	20,730	1,730	c/	12,095
3331	Primary copper	" "	203.9 b/	20,180	64,400	8,585	6,440	15,455
3332	Primary lead	" "	444.9 b/	3,600	6,300	900	1,800	2,700
3333	Primary zinc	" "	259.8 b/	20,150	36,370	1,475	6,880	19,170
3334	Primary aluminum	" "	89.7 b/	132,970 e/	229,125	7,510	7,510	129,210

1/ Computed for industries for which production data are available from data given in 1959 Census of Manufactures-Industrial Water Use and 1959 Industry Statistics, Bureau of the Census, U. S. Department of Commerce.

2/ Dressed weight-carcasses and slaughter house products.

3/ Sausages and other prepared meats. Primarily manufacture of sausages, cured meats, smoked meats, canned meats, frozen meats, other prepared meats, and meat specialties, from purchased carcasses and other materials.

a/ Based on quantities shipped.

b/ Based on total production.

c/ No figure given in census data where total use in industry is less than 500 million gallons.

Table 2 (Cont'd)

d/ 99,365 gallons per ton used for electric generating.

e/ 105,170 gallons per ton used for electric generating.

4/ Primarily manufacture of the following industrial inorganic chemicals: inorganic salts of sodium (excluding refined sodium chloride), potassium, aluminum, calcium, chromium, magnesium, mercury, nickel, silver, tin; inorganic compounds such as alums, calcium carbide, hydrogen peroxide, phosphates, sodium silicate, ammonia compounds and anhydrous ammonia; fertilizer materials such as muriate and sulfate of potash; rare earth metal salts and elemental bromine, fluorine, iodine, phosphorous, and alkali metals (sodium, potassium, lithium, etc.).

Table 3A

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

NEW ENGLAND REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food and kindred products	921	86	1,115	104	10,714	145	582	873
22	Textile mill products	633	69	701	76	9,206	430	45	565
2261	Finishing plants, cotton	1,400	238	1,540	262	5,880	1,260	a/	1,260
26	Paper and allied products	6,115	472	11,953	922	12,960	4,530	352	5,385
2611	Pulp mills	19,180	1,895	29,835	2,947	10,123	14,385	2,664	19,180
2621	Paper mills except building	6,817	479	13,045	917	14,224	5,048	221	5,822
2631	Paperboard mills	3,597	344	13,407	1,281	10,464	2,943	a/	3,270
28	Chemicals and allied products	3,417	191	4,101	230	17,846	683	2,126	3,190
29	Petroleum and coal products	10,897	867	10,897	867	12,573	a/	10,059	10,897
30	Rubber and plastics products	647	66	917	94	9,790	54	485	620
3069	Fabricated rubber products nec	902	98	1,353	147	9,192	56	789	902
31	Leather and leather products	787	103	787	103	7,677	591	a/	787
32	Stone, clay, and glass products	458	38	573	47	12,138	114	114	458

See footnotes at end of table 3 P

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Table 3A

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial Plants using 20 Million Gallons or more per year 1/ 1959

NEW ENGLAND REGION

SIC	Industry	Water intake per employee	Water intake per dollar value added	Gross water use per employee	Gross water use per dollar value added	Value added per employee	Process water per employee	Cooling water per employee	Water discharged per employee
		(1000 gal)	(gal)	(1000 gal)	(gal)	(dollars)	(1000 gal)	(1000 gal)	(1000 gal)
33	Primary metal industries	905	84	1,137	105	10,829	336	336	905
3351	Copper rolling and drawing	1,189	99	1,664	138	12,047	476	396	1,189
34	Fabricated metal products	158	16	190	19	10,022	63	63	158
35	Machinery, except electrical	521	59	600	67	8,893	32	126	474
36	Electrical machinery and equipment	260	28	409	43	9,415	56	56	260
37	Transportation equipment	820	84	832	85	9,785	180	615	567
3722	Aircraft engines and parts	1,749	D	1,749	D	D	397	1,351	1,192

See footnotes at end of table 3P

Table 3B

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 Million Gallons or More per year 1/ 1959

DELAWARE AND HUDSON REGION

SIC	Industry	water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food and kindred products	827	57	4,257	296	14,393	154	551	750
2062	Cane sugar refining	3,650	325	4,088	364	11,243	292	3,212	3,358
22	Textile mill products	612	81	727	96	7,579	344	38	536
23	Apparel	178	19	178	19	9,249	a/	a/	178
26	Paper and allied products	5,703	437	12,072	926	13,039	2,001	233	5,503
2621	Paper mills, except building	13,197	1,018	22,387	1,727	12,961	4,713	353	12,961
2631	Paperboard mills	8,710	648	28,214	2,099	13,444	2,462	379	7,953
28	Chemicals and allied products	2,710	112	4,087	169	24,136	233	2,033	2,521
2813	Industrial gases	19,608	812	24,133	1,000	24,133	a/	19,608	19,608
2815	Intermediate coal tar products	3,803	244	5,936	381	15,583	278	3,154	3,803
2816	Inorganic pigments	8,518	298	10,647	373	28,535	639	5,537	8,092
2818	Organic chemicals nec 2/	4,746	278	5,572	327	17,060	413	3,921	4,127

See footnotes at end of table 3P

Table 3B

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year 1/ 1959

DELAWARE AND HUDSON REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value water per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2819	Inorganic chemicals nec 3/	5,180	306	5,725	339	16,903	273	4,635	5,180
2821	Plastics materials	1,672	100	5,322	317	16,801	228	1,292	1,596
29	Petroleum and coal products	16,564	997	36,228	2,181	16,613	1,066	14,869	16,080
2911	Petroleum refining	17,478	1,036	38,177	2,264	16,865	1,073	15,690	16,967
30	Rubber and plastics products	372	33	604	53	11,426	93	186	325
31	Leather and leather products	703	83	703	83	8,439	352	a/	703
32	Stone, clay, and glass products	1,539	125	2,308	187	12,343	353	224	1,475
3241	Cement, hydraulic	6,387	395	8,782	543	16,168	399	599	5,988
33	Primary metal industries	3,242	272	3,856	323	11,930	388	1,778	3,067
3312	Blast furnaces and steel mills	5,494	411	6,410	479	13,369	576	3,166	5,180
3331	Primary copper	4,311	512	5,683	674	8,426	588	1,764	4,115
34	Fabricated metal products	122	12	196	18	10,609	49	49	122

See footnotes at end of table 3P

Table 3B

Annual Water Use per Employee and per Dollar Value Added by Manufacture
Industrial plants using 20 million gallons or more per year 1/ 1959

DELAWARE AND HUDSON REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water Discharged per employee (1000 gal)
35	Machinery, except electrical	944	86	1,047	96	10,934	34	498	927
3511	Steam engines and turbines	2,669	236	2,669	236	11,288	111	1,335	2,669
36	Electrical machinery and equipment	285	29	324	33	9,724	20	49	285
37	Transportation equipment	102	8	315	25	12,371	19	46	93

See footnotes at end of table 3P

Table 3C

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

CHESAPEAKE BAY REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food and kindred products	742	65	1,127	98	11,490	137	412	687
22	Textile mill products	275	34	366	45	8,144	183	91	275
26	Paper and allied products	8,520	628	53,252	3,927	13,561	4,260	1,207	7,384
2621	Paper mills, except building	6,906	602	76,828	6,699	11,469	3,453	740	6,659
2631	Paperboard mills	10,517	576	22,322	1,224	18,244	5,151	2,361	7,942
28	Chemicals and allied products	5,768	335	8,702	505	17,237	1,267	3,401	5,568
2816	Inorganic Pigments	8,696	458	8,696	458	18,972	1,581	5,534	7,905
2819	Inorganic chemicals nec 3/	17,562	1,196	18,086	1,232	14,679	7,077	6,815	17,562
2823	Cellulosic man-made fibers	4,548	408	11,694	1,050	11,137	557	2,784	4,362

See footnotes at end of table 3P

Table 3C

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

CHESAPEAKE BAY REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
29	Petroleum and coal products	29,586	1,129	30,431	1,161	26,205	a/	**28,740**	28,740
30	Rubber and plastics products	655	74	936	106	8,796	281	281	561
31	Leather and Leather products	712	100	712	100	7,120	655	a/	712
32	Stone, clay, and glass products	527	43	1,293	106	12,164	96	239	479
33	Primary metal industries	4,020	347	6,020	520	11,570	571	2,306	3,877
34	Fabricated metal products	86	7	172	14	11,696	a/	86	86
35	Machinery, except electrical	137	15	228	24	9,296	46	91	137

See footnotes at end of table 3P

Table 3C

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

CHESAPEAKE BAY REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
36	Electrical machinery and equipment	114	13	228	26	9,013	57	57	114
37	Transportation equipment	187	17	249	23	10,861	16	78	171

See footnotes at end of table 3P

Table 3D

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

EASTERN GREAT LAKES-ST. LAWRENCE REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	444	32	839	61	13,837	173	173	395
22	Textile mill prods.	1,173	161	1,408	194	7,274	a/	704	1,173
26	Paper & allied prods.	4,438	469	10,419	1,102	9,454	3,666	193	4,196
2621	Paper mills, except building	6,357	663	13,724	1,432	9,586	5,449	101	6,054
2631	Paperboard mills	7,073	692	14,538	1,423	10,216	4,715	786	6,287
28	Chemicals & allied products	7,289	440	9,316	563	16,560	433	4,829	6,401
2812	Alkalies & chlorine	15,308	1,227	17,551	1,406	12,480	878	10,433	12,188

See footnotes at end of Table 3P.

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Table 3D

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

EASTERN GREAT LAKES-ST. LAWRENCE REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2818	Organic chemicals nec 2/	7,936	344	13,228	574	23,054	a/	7,559	7,936
2819	Inorganic chemicals nec 3/	10,934	715	12,674	829	15,283	248	6,337	10,437
2821	Plastics materials	1,977	101	4,942	253	19,569	395	1,384	1,977
29	Petroleum & coal products	13,024	519	29,113	1,160	25,091	a/	12,258	12,067
2911	Petroleum refining	14,099	535	31,101	1,181	26,332	a/	13,270	13,062

See footnotes at end of Table 3P.

Table 3D

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

EASTERN GREAT LAKES-ST. LAWRENCE REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
30	Rubber & plastics products	909	84	1,640	152	10,765	143	232	856
3011	Tires & innertubes	1,089	95	2,000	174	11,471	177	177	1,013
32	Stone, clay, & glass products	1,382	86	9,296	579	16,065	286	191	1,239
33	Primary metal industries	5,686	418	7,256	533	13,606	1,587	2,234	5,535
3312	Blast furnaces & steel mills	8,574	573	11,193	748	14,964	2,424	3,591	8,350
34	Fabricated metal products	155	16	207	22	9,566	78	52	155
35	Machinery, except electrical	77	7	243	21	11,709	26	26	77
36	Electrical machinery & equipment	108	9	297	25	11,762	41	27	95
37	Transportation equipment	338	26	556	43	12,995	76	58	327

Table 3D (cont'd)

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

EASTERN GREAT LAKES-ST. LAWRENCE REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
3717	Motor vehicles & parts	388	28	614	44	13,823	87	57	375

See footnotes at end of Table 3P.

Table 3E

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

WESTERN GREAT LAKES

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	834	52	1,394	88	15,883	258	379	773
2082	Malt liquors	1,075	64	2,345	140	16,707	293	195	1,075
22	Textile mill prods.	284	38	284	38	7,393	a/	a/	284
26	Paper & allied products	4,405	374	12,958	1,100	11,786	2,689	315	4,148
2621	Paper mills, exc. building	7,611	591	22,231	1,725	12,886	4,748	527	7,084
2631	Paperboard mills	6,558	534	13,751	1,121	12,270	3,808	212	6,347
27	Printing & publishing	112	27	144	34	4,214	48	48	112
28	Chemicals & allied products	4,350	162	6,054	225	26,888	407	3,485	4,146
2818	Organic chemicals nec 2/	10,145	493	14,654	712	20,572	282	8,877	9,722
2819	Inorganic chemicals nec 3/	9,497	443	15,477	721	21,456	1,407	7,035	8,794
2841	Soap & other detergents	3,278	98	4,261	127	33,432	a/	2,951	2,950
29	Petroleum & coal products	12,971	830	25,942	1,660	15,627	2,032	10,627	12,580

See footnotes at end of Table 3P.

Table 3E

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

WESTERN GREAT LAKES

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2911	Petroleum refining	14,811	906	29,802	1,823	16,346	2,258	12,282	14,359
30	Rubber & plastics products	382	37	510	50	10,257	64	255	382
31	Leather & leather products	400	52	400	52	7,724	266	a/	400
32	Stone, clay, & glass products	6,539	487	6,709	500	13,418	255	849	6,200
3241	Cement, hydraulic	19,391	1,440	19,661	1,460	13,466	a/	2,424	18,853
33	Primary metal industries	5,304	446	8,190	689	11,884	1,402	2,077	5,252
3312	Blast furnaces & steel mills	9,039	688	14,015	1,066	13,142	2,358	3,530	8,974
34	Fabricated metal products	136	13	247	23	10,667	62	37	124
35	Machinery, exc. electrical	276	25	376	34	11,009	25	50	276
3522	Farm machinery & equipment	839	90	1,097	118	9,294	a/	65	839
36	Electrical machinery & equipment	80	7	172	15	11,265	40	26	80
37	Transportation equip.	142	11	440	33	13,158	50	37	136
3717	Motor vehicles & parts	127	9	457	33	13,754	52	30	120

See footnotes at end of Table 3P.

Table 3F

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

OHIO REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	843	59	1,447	101	14,268	201	495	769
2011	Meat packing plants b/	781	58	1,136	85	13,422	284	426	781
2085	Distilled liquor, exc. brandy	1,258	55	1,966	86	22,963	79	1,022	1,101
22	Textile mill prods.	339	36	339	36	9,501	a/	a/	339
26	Paper & allied prods.	3,153	259	9,127	750	12,169	1,825	221	2,876
2621	Paper mills, exc. building	3,720	290	7,048	550	12,824	2,056	196	3,328
2631	Paperboard mills	4,186	316	27,904	2,105	13,254	2,790	349	3,488
27	Printing & publishing	135	14	135	14	9,867	68	a/	135
28	Chemicals & allied products	10,217	458	14,574	653	22,309	321	9,001	9,964
2813	Industrial gases	74,024	2,750	75,370	2,800	26,918	a/	64,603	72,678
2815	Intermediate coal tar products	7,375	370	10,365	520	19,932	399	6,777	7,176
2818	Organic chemicals nec 2/	23,487	923	29,750	1,169	25,444	157	22,469	23,017

See footnotes at end of Table 3P.

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Table 3F

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

OHIO REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2819	Inorganic chemicals nec 3/	15,984	873	36,036	1,968	18,309	872	12,206	15,402
2821	Plastics materials	2,007	73	2,509	91	27,429	167	1,338	1,840
29	Petroleum & coal products	6,082	343	25,621	1,445	17,728	518	4,917	4,917
2911	Petroleum refining	6,775	376	29,720	1,650	18,017	308	5,852	5,852
30	Rubber & plastics products	311	28	584	53	11,058	39	195	273
31	Leather & leather products	264	37	264	37	7,118	264	a/	264
32	Stone, clay, & glass products	360	33	829	76	10,871	109	141	328
33	Primary metal indust.	4,810	390	6,521	529	12,333	1,074	2,166	4,657
3312	Blast furnaces and steel mills	5,462	433	7,477	593	12,599	1,380	2,646	5,277
34	Fabricated metal prod.	144	15	198	21	9,590	54	54	126
35	Machinery, exc. elec.	201	17	307	26	11,689	35	47	189
36	Electrical machinery & equipment	178	15	349	30	11,828	69	69	164

See footnotes at end of Table 3P

Table 3F

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

OHIO REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
3632	Household refrigerators	335	34	469	48	9,826	134	168	268
37	Transportation equipment	119	9	330	25	13,215	34	42	102

See footnotes at end of Table 3P

Table 3G

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

UPPER MISSISSIPPI REGION

SIC	Industry	Water intake per employee	Water intake per dollar value added	Gross water use per employee	Gross water use per dollar value added	Value added per employee	Process water per employee	Cooling water per employee	Water discharged per employee
		(1000 gal)	(gal)	(1000 gal)	(gal)	(dollars)	(1000 gal)	(1000 gal)	(1000 gal)
20	Food & kindred products	1,128	84	1,703	126	13,687	219	656	1,036
2011	Meat packing plants b/	560	52	1,033	96	10,764	215	215	538
2046	Wet corn milling	3,671	202	4,659	256	18,213	282	2,400	3,388
24	Lumber & wood products	271	34	271	34	7,857	a/	a/	271
26	Paper & allied products	4,783	367	9,331	716	13,035	3,048	469	4,454
2621	Paper mills, exc. bldg.	6,077	531	10,206	891	11,452	3,739	545	5,765
2631	Paperboard mills	6,169	404	18,801	1,231	15,276	4,407	588	5,288
27	Printing & publishing	81	10	81	10	9,841	a/	a/	81
28	Chemicals & allied products	2,203	97	5,398	237	22,747	551	1,322	2,038
29	Petroleum & coal products	2,257	132	24,372	1,421	17,151	150	1,655	1,655
2911	Petroleum refining	2,455	139	26,355	1,491	17,679	164	1,801	1,801

See footnotes at end of Table 3P

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Table 3G

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

UPPER MISSISSIPPI REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
30	Rubber & plastics products	496	31	744	47	15,989	124	372	496
32	Stone, clay, & glass products	1,713	119	2,977	207	14,353	285	163	1,631
3241	Cement, hydraulic	6,506	303	9,109	424	21,470	651	651	6,181
33	Primary metal industry	2,714	228	5,584	469	11,916	1,310	499	2,308
3312	Blast furnaces & steel mills	4,365	333	10,448	798	13,096	2,719	429	3,507
34	Fabricated metal products	132	11	308	27	11,543	88	44	132
35	Machinery, exc. elec.	314	29	461	43	10,820	29	59	314
3522	Farm machinery & equip.	627	54	10,448	798	13,096	2,719	429	3,507
36	Electrical machinery & equipment	114	11	183	18	10,121	46	23	91
37	Transporation equipment	120	10	440	36	12,113	20	40	120

See footnotes at end of Table 3P

Table 3H

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

LOWER MISSISSIPPI REGION

SIC	Industry	Water intake per employee	Water intake per dollar value added	Gross water use per employee	Gross water use per dollar value added	Value added per employee	Process water per employee	Cooling water per employee	Water discharged per employee
		(1000 gal)	(gal)	(1000 gal)	(gal)	(dollars)	(1000 gal)	(1000 gal)	(1000 gal)
20	Food & kindred products	2,884	222	3,154	243	12,978	270	2,433	2,794
22	Textile mill products	190	26	379	52	7,396	190	a/	190
24	Lumber & wood products	357	71	715	143	5,002	a/	a/	a/
26	Paper & allied products	4,573	302	13,718	906	15,147	3,858	143	4,430
28	Chemicals & allied products	9,126	381	24,108	1,006	23,956	684	6,693	8,594
2818	Organic chemicals nec 2/	11,865	457	25,769	993	25,955	742	9,084	11,680
2819	Inorganic chemicals nec 3/	6,579	304	36,967	1,710	21,617	940	2,506	5,013
29	Petroleum & coal products	11,010	733	42,593	2,837	15,013	222	10,454	10,454
30	Rubber & plastics products	626	52	835	69	12,111	a/	418	626

See footnotes at end of Table 3P

Table 3I

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

MISSOURI REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	1,175	97	1,912	158	12,069	484	484	1,129
2011	Meat packing plants b/	670	66	1,303	128	10,201	335	149	633
2063	Beet sugar	5,379	392	8,338	608	13,717	2,690	2,690	5,379
26	Paper & allied prod.	6,796	625	12,912	1,187	10,873	6,116	340	6,796
28	Chemical & allied products	2,974	110	9,318	346	26,963	198	2,379	2,577
29	Petroleum & coal products	5,921	270	38,006	1,730	21,963	764	4,393	4,775
2911	Petroleum refining	4,811	308	33,985	2,179	15,596	78	4,035	4,655
30	Rubber & plastics products	308	22	1,130	81	13,870	a/	205	308
32	Stone, clay, & glass products	1,884	115	13,607	833	16,328	209	418	1,675
33	Primary metal industries	2,183	145	3,274	218	15,005	1,637	546	2,183
37	Transportation equipment	225	14	376	23	16,685	75	150	225

See footnotes at end of Table 3P

Table 3J
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

TENNESSEE REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	488	51	1,220	128	9,517	244	244	488
22	Textile mill prod.	322	55	322	55	5,849	276	a/	276
26	Paper & allied products	9,028	716	29,063	2,304	12,614	4,947	371	8,657
2621	Paper mills, exc. building	9,849	819	32,590	2,711	12,022	5,359	290	9,560
30	Rubber & plastics products	2,020	172	50,101	4,276	11,717	808	1,212	1,616
28	Chemicals & allied products	6,469	418	8,282	536	15,462	746	5,083	6,327
2819	Inorganic chemicals nec 3/	12,448	462	18,154	673	26,971	2,593	9,855	11,929
2823	Cellulosic man-made fibers 4/	3,782	388	4,363	448	9,745	800	2,400	3,709
32	Stone, clay, & glass products	277	23	277	23	12,209	277	a/	277

See footnotes at end of Table 3P

Table 3J
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

TENNESSEE REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
33	Primary metal industries	741	50	2,222	151	14,741	74	593	667
34	Fabricated metal products	148	24	148	24	6,061	a/	a/	148
36	Electrical machinery and equipment	330	18	330	18	18,134	a/	a/	a/

See footnotes at end of Table 3P

Table 3K
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

SOUTHEAST REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	1,075	96	1,791	159	11,245	193	772	1,020
2037	Frozen fruits & vegetables	5,108	333	6,324	413	15,325	486	4,378	5,108
21	Tobacco products	92	3	1,797	58	30,834	46	a/	46
22	Textile mill products	288	47	440	72	6,077	208	20	256
2211	Weaving mills, cotton	176	31	283	50	5,662	92	15	153
2261	Finishing plants, "	1,122	174	1,402	217	6,449	961	a/	1,041
23	Apparel	400	45	400	45	8,804	45	a/	400
24	Lumber & wood prod.	741	176	988	235	4,201	a/	247	494
25	Furniture & fixtures	102	14	102	14	7,175	a/	a/	102
26	Paper & allied prod.	11,311	719	33,790	2,147	15,741	5,820	1,838	11,004
2611	Pulp mills	22,187	1,063	98,785	4,734	20,866	17,169	528	21,923
2621	Paper mills, exc. bldg.	15,291	874	39,772	2,274	17,487	6,832	1,871	15,047
2631	Paperboard mills	12,914	784	35,562	2,158	16,477	6,044	3,308	12,533

See footnotes at end of Table 3P

Table 3K
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

SOUTHEAST REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
28	Chemicals & allied products	4,739	208	8,816	388	22,736	630	3,182	4,110
2861	Gum & wood chemicals	7,119	418	11,761	691	17,023	309	6,190	6,500
2871	Fertilizers	7,953	600	14,051	1,060	13,256	2,651	3,977	6,363
29	Petroleum & coal products	5,168	286	5,168	286	18,088	a/	5,168	5,168
30	Rubber & plastics products	995	59	1,326	78	16,910	166	663	995
32	Stone, clay, & glass products	1,600	113	2,600	184	14,101	400	200	900
3241	Cement, hydraulic	5,010	234	6,680	312	21,376	1,002	668	2,672
33	Primary metal industries	2,210	187	7,267	614	11,840	515	1,030	1,756
3312	Blast furnaces & steel mills	3,174	246	10,625	825	12,878	690	1,472	2,484
34	Fabricated metal products	249	25	373	38	9,832	a/	a/	249
36	Electrical machinery and equipment	79	6	158	12	12,706	a/	a/	79
37	Transportation equipment	230	24	712	75	9,555	23	184	230

See footnotes at end of Table 3P

Table 3L

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

ARKANSAS-WHITE-RED REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	586	69	1,005	118	8,544	251	168	503
24	Lumber & wood prod.	172	30	515	91	5,666	a/	a/	172
26	Paper & allied "	4,811	308	33,985	2,179	15,596	4,035	78	4,655
2621	Paper mills, exc. building	6,123	430	41,370	2,907	14,231	5,130	a/	5,792
29	Petroleum & coal products	2,612	107	50,930	2,080	24,486	163	1,551	1,143
2911	Petroleum refining	2,635	107	51,392	2,087	24,625	165	1,565	1,153
28	Chemicals & allied products	5,415	257	20,871	989	21,097	564	3,046	4,738
2819	Inorganic chemicals nec 3/	5,410	259	22,154	1,062	20,866	258	1,803	4,637
32	Stone, clay, & glass products	478	29	1,275	77	16,571	319	159	159
33	Primary metal indust.	2,679	199	8,373	622	13,464	1,742	67	622
37	Transportation equip.	25	3	74	9	8,457	a/	a/	25

See footnotes at end of Table 3P

Table 3M
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

WESTERN GULF REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	297	26	1,725	153	11,302	178	59	238
22	Textile mill products	398	67	398	67	5,976	a/	a/	398
24	Lumber & wood products	715	143	1,073	214	5,007	a/	a/	358
26	Paper & allied "	6,153	416	36,916	2,493	14,805	5,191	192	5,191
2621	Paper mills, exc. bldg.	6,085	390	34,921	2,237	15,608	5,026	a/	5,026
28	Chemicals & allied products	35,132	961	56,072	1,534	36,554	7,642	16,904	33,875
2812	Alkalies & chlorine	72,474	2,750	77,599	2,944	26,354	732	36,237	71,742
2819	Inorganic chemicals nec 3/	3,067	134	36,128	1,582	22,836	1,022	1,363	2,045
29	Petroleum & coal products	7,802	530	57,007	3,870	14,732	548	5,633	6,905
2911	Petroleum refining	7,834	517	57,242	3,903	14,667	551	5,657	6,933

See footnotes at end of Table 3P.

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Table 3M
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

WESTERN GULF REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
30	Rubber & plastics products	475	21	951	43	22,338	--	475	a/
32	Stone, clay, & glass products	771	35	1,799	82	21,845	514	a/	514
33	Primary metal industries	5,644	332	18,607	1,093	17,019	441	617	5,026
35	Machinery, except electrical	250	18	2,745	200	13,726	a/	125	250
37	Transportation equipment	84	8	795	77	10,268	42	21	63

See footnotes at end of Table 3P

Table 3N
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

COLORADO REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	746	62	2,985	250	11,940	746	a/	746
33	Primary metal industries	2,337	289	20,824	2,579	8,075	1,487	425	637
3331	Primary copper	5,774	556	55,427	5,333	10,393	4,042	577	1,732

See footnotes at end of Table 3P

Table 3-0
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

CALIFORNIA REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	808	59	1,551	114	13,661	363	264	693
2033	Canned fruits & vegetables	655	51	873	68	12,929	436	109	546
2013	Beet sugar	3,412	294	5,800	500	11,600	1,365	682	2,388
24	Lumber & wood products	1,332	161	2,219	268	8,205	296	74	1,110
2421	Sawmills & planing mills	1,583	198	2,671	333	8,012	396	99	1,286
26	Paper & allied products	4,092	281	27,883	1,917	14,548	2,273	303	3,788
2631	Paperboard mills	6,009	389	25,751	1,667	15,451	4,292	429	6,009
28	Chemicals & allied products	2,782	101	10,454	379	27,569	759	1,770	2,108
2819	Inorganic chemicals nec 3/	3,727	147	23,481	926	25,345	745	2,609	2,982
29	Petroleum & coal products	8,916	462	32,991	1,708	19,319	297	7,965	8,084
2911	Petroleum refining	9,093	473	67,107	3,492	19,217	303	8,063	8,184

See footnotes at end of Table 3P

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Table 3-0
Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

CALIFORNIA REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
30	Rubber & plastics products	104	8	836	66	12,748	a/	104	104
32	Stone, clay, & glass products	1,507	92	2,583	157	16,431	1,005	430	1,292
33	Primary metal industries	506	41	4,344	349	12,442	169	253	380
34	Fabricated metal products	107	8	321	25	13,075	a/	a/	107
35	Machinery, except electrical	89	9	178	18	9,531	a/	a/	a/
36	Electrical machinery and equipment	51	4	51	4	12,789	a/	a/	51
37	Transportation equipment	51	6	180	22	8,362	15	10	46

See footnotes at end of Table 3P

Table 3P

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture
Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

PACIFIC NORTHWEST REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products	1,338	122	2,211	193	11,463	815	407	1,338
2063	Beet sugar	6,544	333	12,435	633	19,633	4,581	1,963	6,544
24	Lumber & wood products	3,079	366	3,634	432	8,405	1,265	250	2,885
2421	Sawmills & planing mills	4,469	533	5,336	636	8,391	912	274	4,241
2432	Veneer & plywood plants	833	99	985	117	8,408	76	303	757
26	Paper & allied products	14,668	761	45,499	2,361	19,269	11,792	1,208	14,265
2621	Paper mills, except building	14,665	800	48,106	2,624	18,331	12,110	889	14,110
2631	Paperboard mills	10,233	414	43,206	1,747	24,730	5,685	2,274	9,665
28	Chemicals & allied products	10,777	444	11,675	481	24,248	449	9,879	9,879

See footnotes at end of Table 3P.

Table 3P

Annual Water Use Per Employee and Per Dollar Value Added by Manufacture Industrial Plants Using 20 Million Gallons or More Per Year 1/ 1959

PACIFIC NORTHWEST REGION

SIC	Industry	Water intake per employee (1000 gal)	Water intake per dollar value added (gal)	Gross water use per employee (1000 gal)	Gross water use per dollar value added (gal)	Value added per employee (dollars)	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
29	Petroleum & coal products	2,294	97	36,697	1,548	23,700	a/	765	1,529
32	Stone, clay, & glass products	1,327	105	1,991	158	12,608	664	664	1,327
33	Primary metal industries	3,479	203	4,812	281	17,101	1,036	1,703	3,183
3334	Primary aluminum	3,862	129	5,069	169	29,930	241	1,690	3,862
37	Transportation equipment	42	5	42	5	8,397	14	14	42

1/ Computed from data given in 1959 Census of Manufactures-Industrial Water Use, Bureau of the Census.

2/ Primarily manufacture of the following industrial chemicals: (1) noncyclic organic chemicals such as acetic. chloroacetic, adipic, formic, oxalic and tartaric acids and their metallic salts; chloral, formaldehyde and methylamine; (2) solvents such as amyl, butyl and ethyl alcohols; methanol; amyl, butyl and ethyl acetates: ethyl ether, ethylene glycol ether and diethylene glycol ether; acetone, carbon disulfide and chlorinated solvents such as carbon tetrachloride, perchloroethylene and trichloroethylene; (3) polyhydric alcohols such as ethylene glycol, sorbitol, pentaerythritol, synthetic glycerin; (4) synthetic perfume and flavoring materials such as coumarin, methyl salicylate, saccharin, citral, citronellal, synthetic geraniol, ionone, terpineol, and synthetic vanillin; (5) rubber processing chemicals such as accelerators and antioxidants, both cyclic and acyclic; (6) plasticizers, both cyclic and acyclic, such as esters of phosphoric acid, phtalic anhydride, aiuouc acid, oleic acid, sebacic acid, and stearic acid; (7) synthetic tanning agents such as naphthalene sulfonic acid condensates; (8) chemical warfare gasses; and (9) esters, aminos, etc., of polyhydric alcohols and fatty and other acids.

Table 3P

3/ Primarily manufacture of the following industrial inorganic chemicals: inorganic salts of sodium (excluding refined sodium chloride), potassium, aluminum, calcium, chromium, magnesium, mercury, nickel, silver, tin: inorganic compounds such as alums, calcium carbide, hydrogen peroxide, phosphates, sodium silicate, ammonia compounds and anhydrous ammonia; fertilizer materials such as suriate and sulfate of potash; rare earth metal salts and elemental bromine, fluorine, iodine, phosphorous, and alkali metals (sodium, potassiu, lithium, etc.).

4/ Primarily manufacture of cellulosic fibers (including cellulose acetate and regenerated cellulose such as rayon by the viscose or duprammenium process) in the form of monofilament, yarn, staple or tow suitable for further manufacturing on spindles, looms, knitting machines or other textile processing equipment.

a/ No figure is given in census data where total use in industry is less than 500 million gallons.

b/ Dressed weight-carcasses and slaughter house products.

5/ Primarily manufacture of industrial and mechanical rubber goods, rubberized fabrics and vulcanized rubber clothing, and miscellaneous rubber specialties and sundries.

D Information withheld to avoid disclosure.

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products						
	U. S. average	915	1,950	1.13	252	493	843
	New England Region	921	1,115	0.21	145	582	873
	Delaware & Hudson	827	4,257	4.15	154	551	750
	Chesapeake Bay	742	1,127	0.52	137	412	687
	Eastern Great Lakes	444	839	0.88	173	173	395
	Western Great Lakes	834	1,394	0.68	258	379	773
	Ohio	843	1,447	0.72	201	495	769
	Upper Mississippi	1,128	1,703	0.51	219	656	1,036
	Lower Mississippi	2,884	3,154	0.10	270	2,433	2,794
	Missouri	1,175	1,912	0.63	484	484	1,129
	Tennessee	488	1,220	1.50	244	244	488
	Southeast	1,075	1,791	0.67	193	772	1,020
	Ark-White-Red	586	1,005	0.71	251	168	503
	Western Gulf	297	1,725	4.81	178	59	238

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Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
20	Food & kindred products (cont'd)						
	Colorado	746	2,985	3.00	746	a/	746
	California	808	1,551	0.92	363	264	693
	Pacific Northwest	1,338	2,211	0.65	815	407	1,338
22	Textile mill products						
	U. S. average	363	490	0.35	240	32	324
	New England Region	633	701	0.11	430	45	565
	Delaware & Hudson	612	727	0.19	344	38	536
	Chesapeake Bay	275	366	0.33	183	91	275
	Eastern Great Lakes	1,173	1,408	0.20	a/	704	1,173
	Western Great Lakes	284	284	0.00	a/	a/	284
	Ohio	339	339	0.00	a/	a/	339
	Lower Mississippi	190	379	0.99	190	a/	190
	Tennessee	322	322	0.00	276	a/	276

a/ No figure given in census report where total industry use is less than 500 million gallons per year.

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
22	Textile mill products (cont'd)						
	Southeast	288	440	0.53	208	20	256
	Western Gulf	398	398	0.00	a/	a/	398

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a/ No figure given in census report where total industry use is less than 500 million gallons per year.

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
26	Paper and allied products						
	U. S. average	6,822	21,418	2.14	4,043	618	6,431
	New England region	6,115	11,953	0.95	4,530	352	5,385
	Delaware & Hudson	5,703	12,072	1.12	2,001	233	5,503
	Chesapeake Bay	8,520	53,252(?)	5.25(?)	4,260	1,207	7,384
	Eastern Great Lakes	4,438	10,419	1.35	3,666	193	4,196
	Western Great Lakes	4,405	12,958	1.94	2,689	315	4,148
	Ohio	3,153	9,127	1.89	1,825	221	2,876
	Upper Mississippi	4,783	9,331	0.95	3,048	469	4,454
	Lower Mississippi	4,573	13,718	2.00	3,858	143	4,430
	Missouri	6,796	12,912	0.90	6,116	340	6,796
	Tennessee	9,028	29,063	2.22	4,947	371	8,657
	Southeast	11,311	33,790	1.99	5,820	1,838	11,004
	Ark-White-Red	4,811	33,985	6.06	4,035	78	4,655
	Western Gulf	6,153	36,916	5.00	5,191	192	5,191
	California	4,092	27,883	5.81	2,273	303	3,788
	Pacific Northwest	14,668	45,499	2.10	11,792	1,208	14,265

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
28	Chemicals and allied products						
	U. S. average	7,616	12,242	0.61	1,011	5,051	7,198
	New England region	3,417	4,101	0.20	683	2,126	3,190
	Delaware & Hudson	2,710	4,087	0.51	233	2,033	2,521
	Chesapeake Bay	5,768	8,702	0.51	1,267	3,401	5,568
	Eastern Great Lakes	7,289	9,316	0.28	433	4,829	6,401
	Western Great Lakes	4,350	6,054	0.39	407	3,485	4,146
	Ohio	10,217	14,574	0.43	321	9,001	9,964
	Upper Mississippi	2,203	5,398	1.45	551	1,322	2,038
	Lower Mississippi	9,126	24,108	1.64	684	6,693	8,594
	Missouri	2,974	9,318	2.13	198	2,379	2,577
	Tennessee	6,469	8,282	0.28	746	5,083	6,327
	Southeast	4,739	8,816	0.86	630	3,182	4,110
	Ark-White-Red	5,415	20,871	2.85	564	3,046	4,738
	Western Gulf	35,132	56,072	0.60	7,642	16,904	33,875
	California	2,782	10,454	2.76	759	1,770	2,108
	Pacific Northwest	10,777	11,675	0.08	449	9,879	9,879

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
29	Petroleum and coal products						
	U. S. average	9,376	40,936	3.37	628	7,842	8,562
	Delaware & Hudson	16,564	36,228	1.19	1,066	14,869	16,080
	New England region	10,897	10,897	0.00	a/	10,059	10,897
	Chesapeake Bay	29,586	30,431	0.03	a/	28,740	28,740
	Eastern Great Lakes	13,024	29,113	1.23	a/	12,258	12,067
	Western Great Lakes	12,971	25,942	1.00	2,032	10,627	12,580
	Ohio	6,092	25,621	3.21	518	4,917	4,917
	Upper Mississippi	2,257	24,372	9.80	150	1,655	1,655
	Lower Mississippi	11,010	42,592	2.87	222	10,454	10,454
	Missouri	5,921	38,006	4.57	764	4,393	4,775
	Southeast	5,168	5,168	0.00	a/	5,168	5,168
	Ark-White-Red	2,612	50,930	18.50	163	1,551	1,143
	Western Gulf	7,802	57,007	6.31	548	5,6[illegible]	6,905
	California	8,916	32,991	2.70	227	7,965	8,084
	Pacific Northwest	2,294	36,697	15.00	a/	765	1,529

a/ No figure given in census where total industry use is less than 500 million gallons per year.

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
33	Primary metal industries						
	U. S. average	4,198	6,365	0.52	1,024	1,781	4,037
	New England region	905	1,137	0.26	336	336	905
	Delaware & Hudson	3,242	3,856	0.19	386	1,778	3,067
	Chesapeake Bay	4,020	6,020	0.50	571	2,306	3,877
	Eastern Great Lakes	5,686	7,256	0.28	1,587	2,234	5,535
	Western Great Lakes	5,304	8,190	0.54	1,402	2,077	5,252
	Ohio	4,810	6,521	0.35	1,074	2,166	4,657
	Upper Mississippi	2,714	5,584	1.06	1,310	499	2,308
	Missouri	2,183	3,274	0.50	1,637	546	2,183
	Tennessee	741	2,222	2.00	74	593	667
	Southeast	2,210	7,267	2.29	515	1,030	1,756
	Ark-White-Red	2,679	8,373	2.12	1,742	67	622
	Western Gulf	5,644	18,607	2.30	441	617	5,026
	Colorado	2,337	20,824	7.91	1,487	425	637
	California	506	4,344	7.58	169	253	380
	Pacific Northwest	3,479	4,812	0.38	1,036	1,703	3,183

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2011	Meat packing plants						
	U. S. average	582	1,141	0.96	260	207	536
	Ohio	781	1,136	0.45	284	426	781
	Upper Mississippi	560	1,033	0.84	215	215	538
	Missouri	670	1,303	0.94	335	149	633
2818	Organic chemicals nec						
	Delaware & Hudson	4,746	5,672	0.19	413	3,921	4,127
	Eastern Great Lakes	7,936	13,228	0.67	a/	7,559	7,936
	Western Great Lakes	10,145	14,654	0.44	282	8,877	9,722
	Ohio	23,487	29,750	0.27	157	22,469	23,017
	Lower Mississippi	11,865	25,769	1.17	742	9,084	11,680

a/ No figure given in census report where total industry is less than 500 million gallons per year.

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recir-culation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2621	Paper mills, except building						
	U. S. average	8,459	26,108	2.09	5,399	513	7,947
	New England region	6,817	13,045	0.91	5,048	221	5,822
	Delaware & Hudson	13,197	22,387	0.70	4,713	353	12,961
	Chesapeake Bay	6,906	76,828	10.12(?)	3,453	740	6,659
	Eastern Great Lakes	6,357	13,724	1.16	5,449	101	6,054
	Western Great Lakes	7,611	22,231	1.92	4,748	527	7,084
	Ohio	3,720	7,048	0.89	2,056	196	3,328
	Upper Mississippi	6,077	10,206	0.68	3,739	545	5,765
	Tennessee	9,849	32,590	2.31	5,359	290	9,560
	Southeast	15,291	39,772	1.60	6,832	1,871	15,047
	Ark-White-Red	6,123	41,370	5.76	5,130	a/	5,792
	Western Gulf	6,085	34,921	4.74	5,026	a/	5,026
	Pacific Northwest	14,665	48,106	2.28	12,110	889	14,110

a/ No figure given in census where total industry use is less than 500 million gallons per year.

Table 4

Annual Water Use Per Employee and Recirculation Ratios, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2631	**Paperboard mills**						
	U. S. average						
	New England region	3,597	13,407	2.73	2,943	a/	3,270
	Delaware & Hudson	8,710	28,214	2.24	2,462	379	7,953
	Chesapeake Bay	10,517	22,322	1.12	5,151	2,361	7,942
	Eastern Great Lakes	7,073	14,538	1.06	4,715	786	6,287
	Western Great Lakes	6,558	13,751	1.10	3,808	212	6,347
	Ohio	4,186	27,904	4.67	2,790	349	3,488
	Upper Mississippi	6,169	18,801	2.05	4,407	588	5,288
	Southeast	12,914	35,562	1.75	6,044	3,308	12,533
	California	6,009	25,751	3.28	4,292	429	6,009
	Pacific Northwest	10,233	43,206	3.22	5,685	2,274	9,665

a/ No figure given in census report where total industry use is less than 500 million gallons per year.

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Table 4

ANNUAL WATER USE PER EMPLOYEE AND RECIRCULATION RATIOS, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2819	Inorganic chemicals nec						
	Delaware & Hudson	5,180	5,725	0.10	273	4,635	5,180
	Chesapeake Bay	17,562	18,086	0.03	7,077	6,815	17,562
	Eastern Gr. Lakes	10,934	12,674	0.16	248	6,337	10,437
	Western Gr. Lakes	9,497	15,477	0.63	1,407	7,035	8,794
	Ohio	15,984	36,036	1.25	872	12,206	15,402
	Lower Mississippi	6,579	36,967	4.62	940	2,506	5,013
	Tennessee	12,448	18,154	0.46	2,593	9,855	11,929
	Ark-White-Red	5,410	22,154	3.10	258	1,803	4,637
	Western Gulf	3,067	36,128	10.78	1,022	1,363	2,045
	California	3,727	23,481	5.30	745	2,609	2,982

Table 4

ANNUAL WATER USE PER EMPLOYEE AND RECIRCULATION RATIOS, 1959

COMPARISON BY REGIONS

SIC Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
2911 Petroleum refining						
U. S. average	9,727	42,790	3.40	631	8,169	8,896
Delaware & Hudson	17,478	38,177	1.18	1,073	15,690	16,967
Eastern Gr. Lakes	14,099	31,101	1.20	a/	13,270	13,062
Western Gr. Lakes	14,811	29,802	1.01	2,258	12,282	14,359
Ohio	6,775	29,720	3.39	308	5,852	5,852
Upper Mississippi	2,455	26,355	9.73	164	1,801	1,801
Missouri	4,811	33,985	6.06	78	4,035	4,655
Ark-White-Red	2,635	51,392	18.50	165	1,565	1,153
Western Gulf	7,834	57,242	6.31	551	5,657	6,933
California	9,093	67,107	6.38	303	8,063	8,184

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a/ No figure given in census report where total industry use is less than 500 million gallons per year.

Table 4

ANNUAL WATER USE PER EMPLOYEE AND RECIRCULATION RATIOS, 1959

COMPARISON BY REGIONS

SIC	Industry	Water intake per employee (1000 gal)	Gross water use per employee (1000 gal)	Recirculation ratio	Process water per employee (1000 gal)	Cooling water per employee (1000 gal)	Water discharged per employee (1000 gal)
3312	Blast furnaces and steel mills						
	U. S. average	6,031	9,207	0.53	1,547	2,685	5,793
	Delaware & Hudson	5,494	6,410	0.17	576	3,166	5,180
	Eastern Gr. Lakes	8,574	11,193	0.30	2,424	3,591	8,350
	Western Gr. Lakes	9,039	14,015	0.55	2,358	3,530	8,974
	Ohio	5,462	7,477	0.37	1,380	2,646	5,277
	Upper Mississippi	4,365	10,448	1.39	2,719	429	3,507
	Southeast	3,174	10,625	2.35	690	1,472	2,484

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Table 5

Comparison of Annual Water Intake Per Employee - Senate Select Committee (1959) vs.

DATA COMPUTED FROM CENSUS OF INDUSTRIAL WATER USE (1959)

SIC	Industry and Region	Senate Select Committee (1959)	Census (1958)
20	Food and kindred products (thousand gallons)		
	U. S. average	900	915
	New England Region	1,190	921
	Delaware and Hudson	680	827
	Chesapeake Bay	927	742
	Eastern Great Lakes	661	444
	Western Great Lakes	729	834
	Ohio	760	843
	Tennessee	770	488
	Southeast	1,204	1,075
	Upper Mississippi	911	1,128
	Lower Mississippi	3,083	2,884
	Missouri	1,104	1,175
	Ark-White-Red	534	586
	Western Gulf	726	297
	Colorado	94	746
	Pacific Northwest	1,198	1,338
26	Paper and allied products (1000 gallons)		
	U. S. average	6.7	6.8
	New England Region	6.6	6.1
	Delaware and Hudson	3.6	5.7
	Chesapeake Bay	7.8	8.5
	Eastern Great Lakes	5.5	4.4
	Western Great Lakes	5.3	4.4
	Ohio	3.0	3.1
	Tennessee	5.3	9.0
	Southeast	9.7	11.3
	Upper Mississippi	5.2	4.7
	Lower Mississippi	5.2	4.5
	Missouri	5.0	6.7
	Ark-White-Red	5.1	4.8
	Western Gulf	7.3	6.1
	Pacific Northwest	13.2	14.6

Table 5

Comparison of Annual Water Intake Per Employee - Senate Select Committee (1959) vs.

DATA COMPUTED FROM CENSUS OF INDUSTRIAL WATER USE (1959)

SIC	Industry and Region	Senate Select Committee (1959)	Census (1958)
28	Chemicals and allied products (million gallons)		
	U. S. average	6.36	7.61
	New England Region	3.47	3.41
	Delaware and Hudson	2.85	2.71
	Chesapeake Bay	6.06	5.76
	Eastern Great Lakes	8.83	7.28
	Western Great Lakes	4.74	4.35
	Ohio	8.73	10.21
	Tennessee	7.69	6.46
	Southeast	5.00	4.73
	Upper Mississippi	1.67	2.20
	Lower Mississippi	4.29	9.12
	Missouri	1.22	2.97
	Ark-White-Red	4.40	5.41
	Western Gulf	22.40	35.13
	Pacific Northwest	12.00	10.77

Table 6a

Water Requirements: Quantities for Various Uses*

Product	Unit	Source of data 1/	Industrial water use, gallons per unit of product
Acetic acid from pyroligneous acid	ton	c	100,000
Acetic acid from pyroligneous liquor	ton	c	240,000
Alcohol, industrial	100 proof gal.	e	120
Alcohol, industrial	190 proof gal.	c	52
Alcohol, industrial	gal. alcohol	b	50 lbs. steam
Alumina (Bayer process)	ton	c	6,300
Ammonia, synthetic	ton liquid NH_3	a,c	31,000
Ammoniated superphosphate	ton	c	27 to 30
Ammonium sulfate	ton salt	a	200,000
Carbon dioxide	ton CO_2	a	23,000
Caustic soda (lime soda process)	ton NaOH	c	18,000
	in 11% solution	a	21,000
Cellulose nitrate	lb. cellulose nitrate	c	50
	ton cellulose nitrate	a	10,000
Cottonseed oil	gal. oil	c	20
Cuprammonium rayon	ton 11% moisture rayon	c	90,000 to 160,000
Glycerine	ton	a	1,300
Gunpowder	ton	a	200,000
Explosives	ton	b	200,000

See footnotes at end of table.

Table 6a

Water Requirements: Quantities for Various Uses*

Product	Unit	Source of data 1/	Industrial water use, gallons per unit of product
Hydrochloric acid (salt process)	ton	c	2,900
Hydrochloric acid (synthetic process)	ton	c	500 to 1,000
Hydrogen	ton H_2	a	660,000
Lactose (milk sugar)	ton	a, c	200,000 to 220,000
Magnesium carbonate, basic	ton	c	4,320
Magnesium hydroxide from sea water & dolomite	ton $Mg(OH)_2$	c	58,000 sea water and 500 fresh water
Oxygen, liquid	cu ft	c	2,000
Phosphoric acid (blast furnace)	ton 100% H_3PO_4	c	75,000
Phosphoric acid (Dorr strong-acid process)	ton 35% P_2O_5 acid	a, c	7,500
Potassium chloride from Sylvinite	ton KCl	c	40,000 to 50,000
Soap, laundry	ton	c	230
Soap, laundry	ton	c	500
Soda ash (ammonia-soda process)	ton 58% soda ash	a, c	15,000 to 18,000
Sodium chlorate	ton	c	60,000
Sulfur dioxide, liquid	ton liquid SO_2	c	18,000
Sulfuric acid (chamber process)	ton 100% H_2SO_4	c	2,500
Sulfuric acid (contact process)	ton 100% H_2SO_4	c	4,000

See footnotes at end of table.

Table 6a

Water Requirements: Quantities for Various Uses*

Product	Unit	Source of data 1/	Industrial water use, gallons per unit of product
Sulfuric acid (contact process)	ton 100% H_2SO_4	b	5,000
Viscose rayon	ton viscose yarn	c	180,000 to 200,000
Beer	bbl	e	470
Whiskey	gal	e	80
Canning:			
Apricots	100 cases No 2 cans	e	8,000
Asparagus	" "	a,e	7,000
Beans, green	" "	a,e	3,500
Beans, lima	" "	a,e	25,000
Pork & beans	" "	a	3,500
Beets	" "	e	2,500
Corn	" "	e	2,500
Corn, cream or whole	" "	a	4,000
Peas	" "	a	3,000
Sauerkraut	" "	a,e	300
Spinach	" "	a,e	16,000
Succotash	" "	e	12,500
Tomato products	" "	a	7,000
Tomatoes, whole	" "	a	750
Corn refining	ton corn	a	333
Edible gelatin	ton	d	13,200 to 20,000
Edible oil	gal	c	22
Meat packing:			
Packing house	100 hog units	a,e	55,000
Poultry	ton live weight	a	4,400
Slaughter house	100 hog units	a,e	16,000
Stockyard	acre	e	160
Milk & milk products:			
Butter	ton	a	5,000
Cheese	ton	a,e	4,000
Dairies	qt milk	b	3
Receiving & bottling	gal milk	a,e	450
Creamery	ton raw	e	220

See footnotes at end of table.

Table 6a

Water Requirements: Quantities for Various Uses*

Product	Unit	Source of data 1/	Industrial water use, gallons per unit of product
Beet sugar	ton refined sugar	c	2,160
Beet sugar	ton sugar	a	20,000 to 25,000
Beet sugar	ton beets	a	2,600 to 3,200
Refined cane sugar	ton sugar	b	1,000
Refined, condensing	ton	c	4,800 to 8,400
Refined, pure water	ton refined sugar	c	1,400
Vegetable dehydration:			
Beets	ton product	a	37,400
Cabbage	" "	a	15,000
Carrots	" "	a	31,600
Potatoes	" "	a	11,200 to 25,000
Rutabagas	" "	a	30,400
Sweet potatoes	" "	a	18,000
Textiles:			
Cotton bleaching	yd	b	25 to 38
Cotton dyeing	100 lb goods	a	1,000 to 2,000
Cotton finishing	yd	b	10 to 15
Cotton processing	100 lb goods	a	3,800
Knit goods, bleaching	ton goods	b	16,000
Linen	ton goods	a	200,000
Rayon:			
Cuprammonium yarn	ton yarn	a	160,000
Dissolving pulp	ton pulp	a	190,000
Viscose yarn	ton yarn	a	200,000
Silk, hosiery dyeing	ton goods	b	6,000 to 8,000
Wool:			
Scouring	100 lb raw wool	a	2,000 to 15,000
Scouring & bleaching	ton goods	b	40,000
Aluminum	ton	b	1,920,000
Cement, portland	ton	b,c	750

See footnotes at end of table.

Table 6a

Water Requirements: Quantities for Various Uses*

Product	Unit	Source of data 1/	Industrial water use, gallons per unit of product
Cement rock, beneficiation	ton raw rock	c	720
Petroleum:			
Gasoline	gal	b	7 to 10
Gasoline, aviation	"	b	25
Gasoline, natural	"	c	20
" "	2000 cu ft stripped gas at 150 lb pressure	c	20
Oil, Fischer-Tropsch synthesis	bbl	f	150,000
Oil fields	bbl crude	a	18,000
Oil refinery	" "	a	77,000
Pulp & paper mills	ton pulp	b	50,000 to 150,000
De-inking paper	ton paper	a	38,000
Paper board	ton paper board	a	14,000
Strawboard	ton strawboard	a	26,000
Sulfate pulp bleaching	ton dry pulp of 80 to 85 G.E. brightness	c	60,224
Rock wool	ton	a,c	4,000 to 5,000
Steel plant	ton	a	20,000 to 35,000
Fabricated steel	"	b	42,000
Ingot steel	"	b	18,000
Pig iron	"	a	4,000
Sulfur mining	"	a	3,000

1/ Source of data:

a/ G. E. Symons, "Treatment of Industrial Wastes," Water & Sewage, Vol. 82, No. 11, November 1944, p. 44.

b/ Journal, Am. Water Works Assn., Vol. 37, No. 9, September 1945, p. 4.

c/ Chemical and Metallurgical Engineering Flow Sheet, 4th Ed. (1944).

d/ Food Industries Flow Sheets of the Food Producing Industry, 2nd Ed. (1947).

e/ H. E. Jordan, "Industrial Requirements for Water," The Johnson National Drillers' Journal, July-August, 1948, p. 7.

f/ W. C. Schroeder, "Comparison of Major Processes for Synthetic Liquid Fuels," Chemical Industries, Vol. 62, No. 4, p. 577, (1948).

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* Source: Manual on Industrial Water and Industrial Waste Water, Second Ed., 1959. ASTM Special Technical Publication No. 148-D.

Table 6b

Water Requirements: Quantities for Various Uses*

Industry	Number of establishments	Units	Gallons per unit	Million gallons (1947)
Steel (finished)	419	tons	65,000	4,020,721
Oil refining	437	bbl	770	1,453,675
Gasoline	-	bbl	357	791,325
Wood pulp:				
Sulfate	226	tons	64,000	342,829
Sulfite	-	"	60,000	167,758
Soda	-	"	85,000	41,784
Groundwood	-	"	5,000	10,249
Paper	665	tons	39,000	415,226
Paperboard	-	"	15,000	137,802
Coke	167	tons	3,600	284,493
Beer	440	bbl	470	41,373
Whiskey	226	gal	80	21,155
Milk, cream, butter	-	lb	0.11-0.25	12,286
Canning and preserving	2,265	cases	7.5-250	8,520
Woolens and worsted fabrics	495	lb	70	3,252
Wool scouring	74	lb	1.26	2,648
Tanning	561	lb	8	1,910
Soap	249	lb	0.25	1.034
Meat packing, hogs	2,153	hogs	11	568
Cane sugar refining	25	tons	1,000	358
Rayon, all types	38	lb	0.16	119

* Source: Industrial Wastes. Their Disposal and Treatment. Edited by Willem Rudolfs. Reinhold Publishing Corporation, New York 1953, Table 1, p. 2.

Table 6c

Water Requirements: Quantities for Various Uses*

User or Product	Units	Gallons of Water/Unit
Alcohol	per gal.	100
Aluminum	per lb.	160
Boilers, steam	per boiler h.p. hr. (100% rating: 100% make-up)	4
Breweries	per bbl.	470
Butadiene	per lb.	160
Canneries:		
apricots	per 100 cases #2 cans	8,000
asparagus		7,000
beans, green, pork and		3,500
beans, lima		25,000
beets, corn, peas		2,500
grapefruit juice		500
grapefruit sections		5,600
peaches, pears		6,500
pumpkin, squash		2,500
sauerkraut		300
spinach		16,000
succotash		12,500
tomatoes, products		7,000
tomatoes, whole		750
Cement	per ton	750
Coke	per ton	3,600
Condensers, surface	per lb. steam condensed	2.4 to 7.2
Dairies, milk products	per 1000 lb. milk processed	
receiving station		180
bottling works		250
cheese factory		200
creamery		110
condensery		150
dry milk factory		150
general dairy		340
Distilleries	per bu. grain mashed	600
Distilling, molasses	1000 gal. 100 proof	8,400
Distilling, cooling water	1000 gal. 100 proof	120,000
Explosives	per lb.	100
Gasoline	per gal.	7 to 10

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* Source: Water Treatment for Industrial and Other Uses. Second Edition. Eskel Nordell. Reinhold Publishing Corporation, New York 1961, Table 5-2, pp. 161-163.

Table 6c

Water Requirements: Quantities for Various Uses*

User or Product	Units	Gallons of Water/Unit
Meat:		
packing plant	per 100 hogs killed	550
slaughterhouse	per 100 hogs killed	550
Oil, edible	per gal.	22
Oil fields, petroleum	per bbl. crude	180
Oil refineries, petroleum	per bbl. crude	770

	Gallons of Water/Ton		
	(max.)	(min.)	(aver.)
Paper pulp:			
ground wood-news	12,800	4,000	9,600
ground wood-specialties	50,000	5,000	28,800
sulfite-unbleached	62,000	40,000	51,000
sulfite-bleaching	92,000	50,000	75,700
sulfite-total bleached	133,000	70,000	92,000
sulfite-news, unbleached	57,000	27,500	43,000
sulfite-(book, waxing, bond, catalog and hanging grades)			
-unbleached	60,000	30,000	39,300
-bleaching	41,600	39,000	40,200
-total bleached	83,100	70,000	75,100
soda-unbleached	34,000	20,000	28,000
soda-bleaching	40,000	12,700	26,000
soda-total bleached	80,000	36,000	58,000
kraft-unbleached	57,000	11,000	34,600
kraft-bleaching	67,000	5,000	36,000
kraft-total bleached	93,000	91,600	92,300
Paper:			
flooring, roofing	12,000	875	6,440
test liner, box, folding, etc.	40,000	6,600	15,000
kraft container	16,000	2,000	9,000
bristols, indexes	30,500	6,700	25,600
rope	--	--	100,000
bonds, etc. (writing, ledger, waxing, parchment)	170,000	12,200	42,500
book (coating stock, catalog, magazine, directory)	90,000	5,000	27,800
kraft (wrapping, bag, liner, corrugated boxboard, cover, tag)	84,700	15,000	36,100
rag (unsized, waterleaf, fine papers)	170,000	27,000	84,300
tissue (kraft, toilet, towel, etc.)	50,000	8,000	29,000
news	33,000	9,500	22,000

* Source: ibid.

Table 6c

Water Requirements: Quantities for Various Uses*

User or Product	Units	Gallons of Water/Unit
Smokeless powder	per ton	50,000
Soap factories	per ton	500
Steel:		
highly finished	1 ton	65,000
Rolled steel:		
cold rolled, high carbon, strip	1 ton	62,000
cold rolled strip	1 ton	6,000
hot rolled steel plates	1 net ton	15,000
rolled steel	1 ton	80,000
rolled steel	1 net ton	110,000
steel sheets and coils	1 ton	13,000
Tanning:		
vegetable	per 100 lb. raw hide	800
chrome	" " " " "	800
Textiles:		
cotton-sizing	per 1000 lb. processed	820
cotton-desizing	" " " "	1,750
cotton-kiering	" " " "	1,240
cotton-bleaching	" " " "	300
cotton-scouring	" " " "	3,400
cotton-mercerising	" " " "	30,000
dyeing-basic	" " " "	18,000
dyeing-direct	" " " "	6,400
dyeing-vat	" " " "	19,000
dyeing-sulfur	" " " "	5,400
dyeing-developed	" " " "	14,400
dyeing-naphthol	" " " "	4,800
dyeing-aniline black	" " " "	15,600
print works	" " " "	4,500
knit goods bleached	per lb.	8
rayon manufacture	per 1000 lb. produced	160
rayon hosiery	per 1000 lb. produced	9,000
silk hosiery dyeing	per lb.	3.5
wool-scouring & bleaching	per lb.	20
wool-finished	per lb.	70

* Source: ibid.

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Table 6d

Water Requirements: Quantities for Various Uses*

User or Product	Units	Water Required (gal)
Alcohol, industrial (100 proof)	gal.	120
Alumina (Bayer process)	ton	6,300
Ammonium sulfate	ton	200,000
Butadiene	ton	20,000 to 660,000 a/
Calcium carbide	ton	30,000
Carbon dioxide (from flue gas)	ton	20,000
Cottonseed oil	gal.	20
Explosives	ton	200,000
Hydrogen	ton	660,000
Oxygen liquid	cu. ft.	2
Soap (laundry)	ton	500
Soda ash	ton	18,000
Sodium chlorate	ton	60,000
Sulfuric acid	ton	650 to 4,875 a/
	Paper and Pulp	
Ground wood pulp (dry)	ton	4,000 to 50,000 a/
Kraft pulp (dry)	ton	93,000
Soda pulp (dry)	ton	85,000
Sulfate pulp (dry)	ton	70,000
Sulfite pulp (dry)	ton	70,000 to 133,000 a/
Paper	ton	39,000
Paperboard	ton	15,000 to 90,000 a/
Strawboard	ton	26,000

See footnotes at end of table.

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Table 6d

Water Requirements: Quantities for Various Uses*

User or Product	Units	Water Required (gal)
Foods and Food Processing		
Bread	ton	500 to 1,000
Canning (#2 cans)	case	8 to 250
Corn (wet milling)	bu.	140 to 240
Corn syrup	bu.	30 to 40
Dairy products:		
bottling	ton	9,000
butter	ton	5,000
cheese	ton	4,000
Gelatin (edible)	ton	13,200 to 20,000 b/
Meat:		
packing	ton c/	4,130
packing house operation	hog unit	550
Sugar:		
beet sugar	ton	2,160
cane sugar	ton	1,000
Petroleum		
Gasoline (natural)	gal.	20
Oil refining	bbl.	770
Refined products	bbl.	150 to 15,000 a/

See footnotes at end of table.

Table 6d

Water Requirements: Quantities for Various Uses*

User or Product	Units	Water Required (gal)
	Synthetic Fuel	
Coal hydrogenates	bbl.	7,296
Coal derivatives	bbl.	11,150
Natural gas derivatives	bbl.	3,736
Shale derivatives	bbl.	873
	Textiles	
Cotton:		
bleaching	ton	60,000 to 80,000
dyeing	ton	8,000 to 16,000
Rayon:		
cuprammonium yarn	ton	90,000 to 160,000 b/
viscose yarn	ton	200,000
weave, dye and finish	yd.	15
Woolens	ton	140,000
	Miscellaneous	
Cement, portland	ton	750
Coal and coke:		
byproduct coke	ton	1,500 to 3,600 b/
washing	ton	200
Electric power, steam-generated	kwhr	80 to 170 a/
Iron ore (brown)	ton	1,000

See footnotes at end of table.

Table 6d

Water Requirements: Quantities for Various Uses*

User or Product	Units	Water Required (gal)
	Miscellaneous	
Hospitals	bed-day	135 to 150
Laundries:		
commercial	ton work	8,600 to 11,400 b/
institutional	ton work	6,000
Leather tanning	raw hide	8
Rock wool	ton	3,000
Steel (rolled)	ton	15,000 to 110,000 a/
Sulfur mining	ton	3,000
Synthetic rubber:		
Buna S	ton	631,450
GR-S	ton	28,000 to 670,000 a/

* Source: Journal American Water Works Association. Vol. 53, No. 4, April 1964, Table 1.4, p. 464.

a/ Range from no reuse to maximum recycling.

b/ Range covers various products or processes involved.

c/ Live animals.

Industrial Waste

The foregoing tables provide information on industrial water use by manufacturing establishments, with the only information pertaining to waste being total volume of water discharged. In water pollution control studies in which the Public Health Service is engaged, it is necessary that estimates of waste loadings by type of manufacturing production be made. In order to furnish some guide to making waste loading estimates, the following tables have been prepared from available sources of information.

Table 7 is a summary of waste discharges, sewered population equivalents, with typical analytical results, for various industrial wastes. Table 8 presents data on the volume and characteristics of wastes from the canning industry. Tables 9 through 13 present waste production data for specified industries.

The waste production data presented should not be used without considerable discretion. They are intended only as guides to estimating waste production for various specified industries.

From the standpoint of estimating pollution loads (versus estimating M and I water supplies), quality and concentration of effluent are a major consideration. In many instances, adoption of technological advances is consistently causing the amount of water withdrawn and used to decrease while production is increasing. This means, therefore, a proportionately higher concentration of pollutants in fewer gallons of wastes discharged. Because of this, whenever production data are available, estimates of future pollution loads should be based on production and not upon employment or on amount of water used. Because of lack of data, however, engineering judgment will be of prime importance in many cases of estimating wastes production.

Table 7

Summary of Waste Discharges, Sewered Population Equivalents, with Typical Analytical Results, for Various Industrial Wastes*

Industry	Unit of daily production	Wastes gallons per unit	Typical analyses, parts per million		Sewered population equivalents 1/	
			Biochemical oxygen demand	Suspended solids	Biochemical oxygen demand	Suspended solids
Brewing	1 barrel of beer	470	1,200	650	19	9
Canning:						
apricots	100 cases No. 2 cans	8,000	1,020	-	410	-
asparagus	"	7,000	100	30	35	9
beans:						
green	"	3,500	200	60	35	9
lima	"	25,000	190	420	240	440
pork and	"	3,500	920	225	160	33
beets	"	3,700	2,600	1,530	480	240
corn:						
cream style	"	2,500	620	300	75	30
whole kernel	"	2,500	2,000	1,250	250	130
grapefruit:						
juice	"	500	310 a/	170 a/	8 a/	3 a/
sections	"	5,600	1,850	270	520	63
peaches, pears	100 cases cans(size unknown)	6,500	1,340	-	440	-
peas	100 cases No. 2 cans	2,500	1,700	400	210	40
pumpkin, squash	100 cases No. 2½ cans	2,500	6,400	1,850	800	190
sauerkraut	100 cases No. 2 cans	300	6,300	630	100	8
succotash	"	12,500	520	250	330	130
spinach	"	16,000	620	-	490	-
tomatoes:						
products	"	7,000	11,000	500	350	150
whole	"	750	4,000	2,000	150	60

1/ Persons per unit of daily production a/ Excluding peel bin wastes.

* Source: House Document No. 266, 78th Congress, 1st session. Ohio River Pollution Control, 1944, pp. 1033-1035.

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Table 7

Summary of Waste Discharges, Sewered Population Equivalents, with Typical Analytical Results, for Various Industrial Wastes*

Industry	Unit of daily production	Wastes gallons per unit	Typical analyses, parts per million		Sewered population equivalents 1/	
			Biochemical oxygen demand	Suspended solids	Biochemical oxygen demand	Suspended solids
Distilling, molasses	1000 gallons 100 proof	8,400	33,000	3,270	12,000	1,000
cooling water	"	120,000	-	-	-	-
Meat:						
packing house	100 hog units of kill	550	900	650	77 b/	25 b/
slaughterhouse	"	160	2,200	930	18	6
poultry	1000 lbs. live weight	2,200	-	-	300	160
Milk:						
receiving station	1000 lbs. raw milk & cream	180	500	-	4	2
bottling works	"	250	-	-	6	3
cheese factory	"	200	1,100	750	16	9
creamery	"	110	1,250	660	6	3
condensery	"	150	1,300	750	7	4
dry milk	"	150	480	-	6	3
general dairy	"	340	570	540	10	5
Oil field	100 barrels crude oil	18,000	-	-	-	-
Oil refining	"	77,000	20	50	60	120
Paper:						
paper mill (no bleaching)	1 ton paper	39,000	19	452	26	520
paper mill (bleached)	"	47,000	24	156	40	220
pasteboard	"	14,000	121	660	97	445
strawboard	"	26,000	965	1,790	1,230	1,920
Paper pulp:						
ground wood	1 ton dry pulp	5,000	645	-	16	-
soda	"	85,000	110	1,720	460	6,100
sulfate (kraft)	"	64,000	123	-	390	-
sulfite	"	60,000	443	-	1,330	-

b/ Paunch manure to sewer.

* Source: ibid.

Table 7

Summary of Waste Discharges, Sewered Population Equivalents, with Typical Analytical Results, for Various Industrial Wastes*

Industry	Unit of daily production	Wastes gallons per unit	Typical analyses, parts per million		Sewered population equivalents 1/	
			Biochemical oxygen demand	Suspended solids	Biochemical oxygen demand	Suspended solids
Tanning:						
vegetable	100 lbs. raw hides	800	1,200	2,400	48	80
chrome	"	-	-	-	24	40
Textile:						
cotton:						
sizing	1000 lbs. goods processed	60	820	-	2	-
desizing	"	1,000	1,750	-	96	-
kiering	"	1,700	1,240	-	108	-
bleaching	"	1,200	300	-	17	-
scouring	"	3,400	72	-	12	-
mercerizing	"	30,000	55	-	83	-
dyeing:						
basic	"	18,000	100	-	100	-
direct	"	6,400	220	-	71	-
vat	"	19,000	140	-	130	-
sulfur	"	5,400	1,300	-	360	-
developed	"	14,400	170	-	120	-
naphthol	"	4,800	250	-	59	-
aniline black	"	15,600	55	-	41	-
print works	"	4,500	95	-	15	-
finishing	"	6	1,250	-	0.4	-
rayon manufacture	1 cord wood distilled	680,000	30	-	1,000	-
" "	1000 lbs. rayon produced	160,000	4.4	19	35	130
" "	"	140,000	110	96	800	580
rayon hosiery	1000 lbs. hose produced	9,000	330	-	150	-
silk hosiery	"	13,700	1,720	-	1,180	-
Woolen mill	1000 lbs. finished goods	70,000	114	-	400	-
scouring & dyeing	"	240,000	125	-	1,500	-

1/ Persons per unit of daily production.
* Source: ibid.

Table 8

Volume and Characteristics of Cannery Wastes *

Product	Volume per case (gals)	5-Day BOD (ppm)	Suspended solids (ppm)
Apples, sauce		1,685-3,453	
Apricots	57-80	200-1,020	260
Asparagus	70	100	30
Beans, green or wax	26-44	160-600	60-85
Beans, lima	50-257	189-450	422
Beans, baked	35	925-1,440	225
Beets	27-65	1,580-5,480	740-2,188
Carrots	23	520-3,030	1,830
Corn, cream style	24	623	302
Corn, whole kernel	25-70	1,123-6,025	300-4,000
Cherries, sour	12-40	700-2,100	20-605
Grapefruit	5-56	310-2,000	170-287
Mushrooms	6,600a/	76-390	50-242
Peaches	1,300-2,600a/	1,350	600
Pears	1,300a/	2,250-4,700	1,200-6,700
Peas	14-56	380-4,700	272,400
Potatoes, sweet	3,500a/	295	610
Potatoes, white		200-2,900	990-1,180
Pumpkin	20-42	2,850-6,875	785-3,500
Sauerkraut	3	6,300	630
Spinach	160	280-730	90-580
Tomatoes, whole	3-15	570-4,000	190-2,000
Tomatoes, juice or products	38-100	178-3,880	170-1,168

a/ Per ton

*Source: Industrial Wastes. Their Disposal and Treatment. Edited by Willem Rudolfs. Reinhold Publishing Corp. New York, 1953, Table 2, p. 57.

TABLE 9

Volume and character of wastes from raw cane sugar production Louisiana (2,400 tons cane daily capacity)

Kind of waste	Average flow rate (gpm)	Average ppm 5 day BOD	Total daily BOD load (lbs)
Cane wash water	1,000	680	8,157
Floor washings plus boiler blowdown	100	378	453
Soda and acid wastes	10	NaOH, NaCl & HCl	-
Excess condensate	50	10	6
Condenser water 1/	5,000	69	4,138
Totals	6,160	-	12,754
Average per ton daily capacity	-	-	5.31

1/ Assumes once through operation.
Source: An Industrial Waste Guide to the Cane Sugar Industry. U.S.D.H.E.W. Public Health Service, 1963, Table 1, p. 8.

TABLE 10

Strength of wastes from typical fruit-canning operations

Fruit product	Waste volume	5-day BOD	Suspended solids
	gal/case	ppm	ppm
Apples	25-40	1,680-5,530	300-600
Apricots	57-80	200-1,020	200-400
Cherries	12-40	700-2,100	200-600
Cranberries	10-20	500-2,250	100-250
Peaches .	45-60	1,200-2,800	450-750

Source: An Industrial Waste Guide to the Fruit Processing Industry. U.S.D.H.E.W. Public Health Service, 1962, Table 2, p. 4.

TABLE 11

Potato Chip Industry
Solids balance and BOD relationship per 1,000 pounds potatoes (11) a/

Plant	Dry weight 1/ (1)	Chips produced 2/ (2)	Dry weight (3)	Oil in chip 3/ (4)	Dry solids produced (5)	Solids lost (1)-(5) (6)	BOD of solids lost (7)	BOD in sewer (8)
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
A	177	240	234	96	138	39	17.7	15.0
B	210	260	254	104	150	60	27.2	26.2
C	200	240	234	96	138	62	28.1	30.8
D	210	255	249	102	147	63	28.5	(14.5)*
Average	200	249	243	100	143	56	25.4	25.0

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11 **Porges**, R., "Waste Loadings from Potato Chip Plants". Sewage and Industrial Wastes, 24, 8, 1001-4 (Aug. 1959).

1/ Dry-solids variation probably due to seasonal variation. 2/ 2½% moisture. 3/ Chip contains 40% oil.
4/ BOD per pound solids -0.453. *Omitted from average as much solid material removed manually. Replaced by adjusted value of 28.1.

a/ Source: An industrial waste guide to the Potato Chip Industry. U.S.D.H.E.W. Public Health Service, 1961, Table III, p. 4.

TABLE 12

Pollution Effect of Cotton Processing Wastes (Composite of All Wastes Connected with Each Process) 1/

Process	Wastes (ppm) BOD	Wastes (ppm) Total solids	Gallons wastes per 1,000 lbs. goods	Pounds BOD per 1,000 lbs. goods	Pounds total solids per 1,000 lbs. goods	Population equivalent per 1,000 lbs. goods
Slashing, sizing yarn*	620-5,200	8,500-22,600	60-940	0.5-5.0	47-67	2-30
Desizing	1,700-5,200	16,000-32,000	300-1,100	14.8-16.1	66-70	90-100
Kiering	680-2,900	7,600-17,400	310-1,700	1.5-17.5	19-47	10-105
Scouring	50-110	---	2,300-5,100	1.36-3.02	---	8-18
Bleaching (range)	90-1,700	2,300-14,400	300-14,900	5.0-14.8	38-290	30-90
Mercerizing	45-65	600-1,900	27,900-36,950	10.5-13.5	185-450	60-80
Dyeing:						
Aniline black	40-55	600-1,200	15,000-23,000	5-10	100-200	40-60
Basic	100-200	500-800	18,000-36,000	15-50	150-250	100-400
Developed colors	75-200	2,900-8,200	8,900-25,000	15-20	325-650	90-120
Direct	220-600	2,200-14,000	1,700-6,400	1.3-11.7	25-250	25-75
Indigo	90-1,700	1,100-9,500	600-6,000	1.8-9.5	21-63	10-60
Naphthol	15-675	4,500-10,700	2,300-16,800	2-15	200-650	13-80
Sulfur	11-1,800	4,200-14,100	2,900-25,600	2-250	300-1,200	14-1,500
Vats	125-1,500	1,700-7,400	1,000-20,000	12-30	150-250	75-175

* Cloth weaving mill waste.

1/ Source: An Industrial Waste Guide to the Cotton Textile Industry. U.S.D.H.E.W., Public Health Service, 1959, Table II, p. 8.

TABLE 13

Approximate Quantities of BOD in Various Process Wastes from Milk Processing 1/

PROCESS	Pounds of 5-day BOD per 10,000 pounds milk or milk equivalent
Receiving and cooling milk	4
Tank-truck delivery to & from plant including washing tank truck	1
Storage of fluid milk, separated milk or whey in tanks	0.5
Storage of other fluid products	1
Evaporating whole milk, floor waste	2
Evaporating whole milk, entrainment loss	1
Canning and sterilizing evaporated milk	2
Spray drying whole milk	1
Cream separating	2
Cream pasteurization, cooling & can filling	2
Separated milk pasteurization, cooling, & can filling	2
Cottage cheese or casein manufacture	16
American-cheese making, unwashed curd	10
American-cheese making, washed curd	16
Separated-milk condensing, plain, floor waste	3
Separated-milk condensing, plain, entrainment loss	0.5
Separated-milk condensing, sweetened, including barreling floor waste	6
Separated-milk condensing, sweetened, entrainment loss	0.5
Separated-milk condensing, superheated	12
Separated-milk drying, spray process	1
Separated-milk drying, roll process	16
Whey condensing, sweet, floor waste	8
Whey condensing, sweet, entrainment loss & volatile	2
Whey condensing, acid, floor waste	8
Whey condensing, acid entrainment loss & volatile	4
Whey drying, spray	5
Buttermilk condensing, floor waste	8
Buttermilk condensing, entrainment loss & volatile	4
Milk pasteurization, cooling & bottling (glass)	8
Milk pasteurization, cooling & bottling (paper)	6
Ice-cream-mix making, vat	4
Ice-cream-mix making, pan	4
Ice cream freezing	0.5
Cultured-buttermilk making	5
Butter churning and washing	2

1/ Source: An Industrial Waste Guide to the Milk Processing Industry. U.S.D.H.E.W., Public Health Service, 1959, Table MK-3, p. 7.

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STANDARD INDUSTRIAL CLASSIFICATION

Major Group 20-FOOD AND KINDRED PRODUCTS

Group No.	Industry No.	
201		MEAT PRODUCTS
	2011	Meat packing plants
	2013	Sausages and other prepared meat products
	2015	Poultry and small game dressing and packing, wholesale
202		DAIRY PRODUCTS
	2021	Creamery butter
	2022	Natural cheese
	2023	Condensed and evaporated milk
	2024	Ice cream and frozen desserts
	2025	Special dairy products
	2026	Fluid milk
203		CANNING AND PRESERVING FRUITS, VEGETABLES, AND SEA FOODS
	2031	Canned and cured sea foods
	2032	Canned specialties
	2033	Canned fruits, vegetables, preserves, jams, and jellies
	2034	Dried and dehydrated fruits and vegetables
	2035	Pickled fruits and vegetables; vegetable sauces and seasonings; salad dressings
	2036	Fresh or frozen packaged fish
	2037	Frozen fruits, fruit juices, vegetables, and specialties
204		GRAIN MILL PRODUCTS
	2041	Flour and other grain mill products
	2042	Prepared feeds for animals and fowls
	2043	Cereal preparations
	2044	Rice milling
	2045	Blended and prepared flour
	2046	Wet corn milling
205		BAKERY PRODUCTS
	2051	Bread and other bakery products, except biscuit, crackers, and pretzels
	2052	Biscuit, crackers, and pretzels
206		SUGAR
	2061	Cane sugar, except refining only
	2062	Cane sugar refining
	2063	Beet sugar

Group No.	Industry No.	
207		CONFECTIONERY AND RELATED PRODUCTS
	2071	Candy and other confectionery products
	2072	Chocolate and cocoa products
	2073	Chewing gum
208		BEVERAGE INDUSTRIES
	2082	Malt liquors
	2083	Malt
	2084	Wines, brandy, and brandy spirits
	2085	Distilled, rectified, and blended liquors
	2086	Bottled and canned soft drinks and carbonated waters
	2087	Flavoring extracts and flavoring sirups, not elsewhere classified
209		MISCELLANEOUS FOOD PREPARATIONS AND KINDRED PRODUCTS
	2091	Cottonseed oil mills
	2092	Soybean oil mills
	2093	Vegetable oil mills, except cottonseed and soybean
	2094	Grease and tallow
	2095	Animal and marine fats and oils, except grease and tallow
	2096	Shortening, table oils, margarine and other edible fats and oils, not elsewhere classified
	2097	Manufactured ice
	2098	Macaroni, spaghetti, vermicelli, and noodles
	2099	Food preparations, not elsewhere classified

Major Group 21-TOBACCO MANUFACTURES

211		CIGARETTES
	2111	Cigarettes
212		CIGARS
	2121	Cigars
213		TOBACCO (CHEWING AND SMOKING) AND SNUFF
	2131	Tobacco (chewing and smoking) and snuff
214		TOBACCO STEMMING AND REDRYING
	2141	Tobacco stemming and redrying

Major Group 22-TEXTILE MILL PRODUCTS

221		BROAD WOVEN FABRIC MILLS, COTTON
	2211	Broad woven fabric mills, cotton

Group No.	Industry No.	
222		BROAD WOVEN FABRIC MILLS, MAN-MADE FIBER AND SILK
	2221	Broad woven fabric mills, man-made fiber and silk
223		BROAD WOVEN FABRIC MILLS, WOOL: INCLUDING DYEING AND FINISHING
	2231	Broad woven fabric mills, wool: including dyeing and finishing
224		NARROW FABRICS AND OTHER SMALLWARES MILLS: COTTON, WOOL, SILK, AND MAN-MADE FIBER
	2241	Narrow fabrics and other smallwares mills: cotton, wool, silk, and man-made fiber
225		KNITTING MILLS
	2251	Full-fashioned hosiery mills
	2252	Seamless hosiery mills
	2253	Knit outerwear mills
	2254	Knit underwear mills
	2256	Knit fabric mills
	2259	Knitting mills, not elsewhere classified
226		DYEING AND FINISHING TEXTILES, EXCEPT WOOL FABRICS AND KNIT GOODS
	2261	Finishers of broad woven fabrics of cotton
	2262	Finishers of broad woven fabrics of man-made fiber and silk
	2269	Dyeing and finishing textiles, not elsewhere classified
227		FLOOR COVERING MILLS
	2271	Woven carpets and rugs
	2272	Tufted carpets and rugs
	2279	Carpets, rugs, and mats, not elsewhere classified
228		YARN AND THREAD MILLS
	2281	Yarn spinning mills, cotton, man-made fibers and silk
	2282	Yarn throwing, twisting, and winding mills, cotton, man-made fibers and silk
	2283	Yarn mills, wool, including carpet and rug yarn
	2284	Thread mills
229		MISCELLANEOUS TEXTILE GOODS
	2291	Felt goods, except woven felts and hats
	2292	Lace goods
	2293	Paddings and upholstery filling
	2294	Processed waste and recovered fibers and flock
	2295	Artificial leather, oilcloth, and other impregnated and coated fabrics except rubberized
	2296	Tire cord and fabric

Group No.	Industry No.	
	2297	Wool scouring, worsted combing, and tow to top mills
	2298	Cordage and twine
	2299	Textile goods, not elsewhere classified
		Major Group 23-APPAREL AND OTHER FINISHED PRODUCTS MADE FROM FABRICS AND SIMILAR MATERIALS
231		MEN'S, YOUTHS', AND BOYS' SUITS, COATS, AND OVERCOATS
	2311	Men's, youths', and boys' suits, coats, and overcoats
232		MEN'S, YOUTHS', AND BOYS' FURNISHINGS, WORK CLOTHING, AND ALLIED GARMENTS
	2321	Men's, youths', and boys' shirts (except work shirts), collars, and nightwear
	2322	Men's, youths', and boys' underwear
	2323	Men's, youths', and boys' neckwear
	2327	Men's, youths', and boys' separate trousers
	2328	Work clothing
	2329	Men's, youths', and boys' clothing, not elsewhere classified
233		WOMEN'S, MISSES', AND JUNIORS' OUTERWEAR
	2331	Blouses, waists, and shirts
	2337	Suits, skirts, and coats, except fur coats and raincoats
	2335	Dresses
	2339	Women's, misses', and juniors' outerwear, not elsewhere classified
234		WOMEN'S, MISSES', CHILDREN'S, AND INFANTS' UNDER GARMENTS
	2341	Women's, misses', children's, and infants' underwear and nightwear
	2342	Corsets and allied garments
235		HATS, CAPS, AND MILLINERY
	2351	Millinery
	2352	Men's and boys' hats and caps
236		GIRLS', CHILDREN'S, AND INFANTS' OUTERWEAR
	2361	Dresses, blouses, waists, and shirts
	2363	Coats and suits
	2369	Girls', children's, and infants' outerwear not elsewhere classified
237		FUR GOODS
	2371	Fur goods

Group No.	Industry No.	
238		MISCELLANEOUS APPAREL AND ACCESSORIES
	2381	Dress and work gloves, except knit and all leather
	2384	Robes and dressing gowns
	2385	Raincoats and other waterproof outer garments
	2386	Leather and sheep lined clothing
	2387	Apparel belts
	2389	Apparel, not elsewhere classified
239		MISCELLANEOUS FABRICATED TEXTILE PRODUCTS
	2391	Curtains and draperies
	2392	Housefurnishings, except curtains and draperies
	2393	Textile bags
	2394	Canvas products
	2395	Pleating, decorative and novelty stitching, and tucking for the trade
	2396	Apparel findings and related products
	2397	Schiffli machine embroideries
	2399	Fabricated textile products, not elsewhere classified
	Major Group 24-LUMBER AND WOOD PRODUCTS, EXCEPT FURNITURE	
241		LOGGING CAMPS AND LOGGING CONTRACTORS
	2411	Logging camps and logging contractors
242		SAWMILLS AND PLANING MILLS
	2421	Sawmills and planing mills, general
	2426	Hardwood dimension and flooring mills
	2429	Special product sawmills, not elsewhere classified
243		MILLWORK, VENEER, PLYWOOD, AND PREFABRICATED STRUCTURAL WOOD PRODUCTS
	2431	Millwork plants
	2432	Veneer and plywood plants
	2433	Prefabricated wooden buildings and structural members
244		WOODEN CONTAINERS
	2441	Nailed and lock corner wooden boxes and shook
	2442	Wirebound boxes and crates
	2443	Veneer and plywood containers, except boxes and crates
	2445	Cooperage
249		MISCELLANEOUS WOOD PRODUCTS
	2491	Wood preserving
	2499	Wood products, not elsewhere classified

Group No.	Industry No.	
		Major Group 25 -- FURNITURE AND FIXTURES
251		HOUSEHOLD FURNITURE
	2511	Wood household furniture, except upholstered
	2512	Wood household furniture, upholstered
	2514	Metal household furniture
	2515	Mattresses and bedsprings
	2519	Household furniture, not elsewhere classified
252		OFFICE FURNITURE
	2521	Wood office furniture
	2522	Metal office furniture
253		PUBLIC BUILDING AND RELATED FURNITURE
	2531	Public building and related furniture
254		PARTITIONS, SHELVING, LOCKERS, AND OFFICE AND STORE FIXTURES
	2541	Wood partitions, shelving, lockers, and office and store fixtures
	2542	Metal partitions, shelving, lockers, and office store fixtures
259		MISCELLANEOUS FURNITURE AND FIXTURES
	2591	Venetian blinds and shades
	2599	Furniture and fixtures, not elsewhere classified
		Major Group 26 - PAPER AND ALLIED PRODUCTS
261		PULP MILLS
	2611	Pulp mills
262		PAPER MILLS, EXCEPT BUILDING PAPER MILLS
	2621	Paper mills, except building paper mills
263		PAPERBOARD MILLS
	2631	Paperboard mills
264		CONVERTED PAPER AND PAPERBOARD PRODUCTS, EXCEPT CONTAINERS AND BOXES
	2641	Paper coating and glazing
	2642	Envelopes
	2643	Bags, except textile bags
	2644	Wallpaper
	2645	Die cut paper and paperboard; and cardboard

Group No.	Industry No.	
	2646	Pressed and molded pulp goods
	2649	Converted paper and paperboard products, not elsewhere classified
265		PAPERBOARD CONTAINERS AND BOXES
	2651	Folding paperboard boxes
	2652	Set-up paperboard boxes
	2653	Corrugated and solid fiber boxes
	2654	Sanitary food containers
	2655	Fiber cans, tubes, drums, and similar products
266		BUILDING PAPER AND BUILDING BOARD MILLS
	2661	Building paper and building board mills

Major Group 27 - PRINTING, PUBLISHING, AND ALLIED INDUSTRIES

Group No.	Industry No.	
271		NEWSPAPERS: PUBLISHING, PUBLISHING AND PRINTING
	2711	Newspapers: publishing, publishing and printing
272		PERIODICALS: PUBLISHING, PUBLISHING AND PRINTING
	2721	Periodicals: publishing, publishing and printing
273		BOOKS
	2731	Books: publishing, publishing and printing
	2732	Book printing
274		MISCELLANEOUS PUBLISHING
	2741	Miscellaneous publishing
275		COMMERCIAL PRINTING
	2751	Commercial printing, except lithographic
	2752	Commercial printing, lithographies
	2753	Engraving and plate printing
276		MANIFOLD BUSINESS FORMS MANUFACTURING
	2761	Manifold business forms manufacturing
277		GREETING CARD MANUFACTURING
	2771	Greeting card manufacturing
278		BOOKBINDING AND RELATED INDUSTRIES
	2782	Blankbooks, loose leaf binders and devices
	2789	Bookbinding, and miscellaneous related work
279		SERVICE INDUSTRIES FOR THE PRINTING TRADE
	2791	Typesetting
	2793	Photoengraving

Group No.	Industry No.	
	2794	Electrotyping and stereotyping
	2799	Service industries for the printing trades, not elsewhere classifed
		Major Group 28 - CHEMICALS AND ALLIED PRODUCTS
281		INDUSTRIAL INORGANIC AND ORGANIC CHEMICALS
	2812	Alkalies and chlorine
	2813	Industrial gases
	2814	Cyclic (coal tar) crudes
	2815	Dyes, dye (cyclic) intermediates, and organic pigments (lakes and toners)
	2816	Inorganic pigments
	2818	Industrial organic chemicals, not elsewhere classified
	2819	Industrial inorganic chemicals, not elsewhere classified
282		PLASTICS MATERIALS AND SYNTHETIC RESINS, SYNTHETIC RUBBER, SYNTHETIC AND OTHER MAN-MADE FIBERS, EXCEPT GLASS
	2821	Plastics materials, synthetic resins, and nonvulcanizable elastomers
	2822	Synthetic rubber (vulcanizable elastomers)
	2823	Cellulosic man-made fibers
	2824	Synthetic organic fibers, except cellulosic
283		DRUGS
	2831	Biological products
	2833	Medicinal chemicals and botanical products
	2834	Pharmaceutical preparations
284		SOAP, DETERGENTS AND CLEANING PREPARATIONS, PERFUMES, COSMETICS, AND OTHER TOILET PREPARATIONS
	2841	Soap and other detergents, except specialty cleaners
	2842	Specialty cleaning, polishing, and sanitation preparations, except soap and detergents
	2843	Surface active agents, finishing agents, sulfonated oils and assistants
	2844	Perfumes, cosmetics, and other toilet preparations
285		PAINTS, VARNISHES, LACQUERS, ENAMELS, AND ALLIED PRODUCTS
	2851	Paints, varnishes, lacquers, and enamels
	2852	Putty, calking compounds, and allied products
286		GUM AND WOOD CHEMICALS
	2861	Gum and wood chemicals

Group No.	Industry No.	
287		AGRICULTURAL CHEMICALS
	2871	Fertilizers
	2872	Fertilizers, mixing only
	2873	Agricultural pesticides
	2879	Agricultural chemicals, not elsewhere classified
289		MISCELLANEOUS CHEMICAL PRODUCTS
	2891	Glue and gelatin
	2892	Explosives
	2893	Printing ink
	2894	Fatty acids
	2895	Carbon black
	2899	Chemicals and chemical preparations, not elsewhere classified
291		PETROLEUM REFINING
	2911	Petroleum refining
295		PAVING AND ROOFING MATERIALS
	2951	Paving mixtures and blocks
	2952	Asphalt felts and coatings
299		MISCELLANEOUS PRODUCTS OF PETROLEUM AND COAL
	2992	Lubricating oils and greases
	2999	Products of petroleum and coal, not elsewhere classified

Major Group 30 - RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS

301		TIRES AND INNER TUBES
	3011	Tires and inner tubes
302		RUBBER FOOTWEAR
	3021	Rubber footwear
306		FABRICATED RUBBER PRODUCTS, NOT ELSEWHERE CLASSIFIED
	2069	Fabricated rubber products, not elsewhere classified
307		MISCELLANEOUS PLASTICS PRODUCTS
	3079	Miscellaneous plastics products

Major Group 30 - LEATHER AND LEATHER PRODUCTS

311		LEATHER TANNING AND FINISHING
	3111	Leather tanning and finishing
312		INDUSTRIAL LEATHER BELTING AND PACKING
	3121	Industrial leather belting and packing

Group No.	Industry No.	
313		BOOT AND SHOE CUT STOCK AND FINDINGS
	3131	Boot and shoe cut stock and findings
314		FOOTWEAR, EXCEPT RUBBER
	3141	Footwear, except house slippers and rubber footwear
	3142	House slippers
315		LEATHER GLOVES AND MITTENS
	3151	Leather dress, semidress, and work gloves
316		LUGGAGE
	3161	Luggage
317		HANDBAGS AND OTHER PERSONAL LEATHER GOODS
	3171	Women's handbags and purses
	3172	Personal leather goods, except handbags and purses
319		LEATHER GOODS, NOT ELSEWHERE CLASSIFIED
	3199	Leather goods, not elsewhere classified

Major Group 32 - STONE, CLAY, AND GLASS PRODUCTS

Group No.	Industry No.	
321		FLAT GLASS
	3211	Flat glass
322		GLASS AND GLASSWARE, PRESSED OR BLOWN
	3221	Glass container
	3229	Pressed and blown glass and glassware, not elsewhere classified
323		GLASS PRODUCTS, MADE OF PURCHASED GLASS
	3231	Glass products, made of purchased glass
324		CEMENT, HYDRAULIC
	3241	Cement, hydraulic
325		STRUCTURAL CLAY PRODUCTS
	3251	Brick and structural clay tile
	3253	Ceramic wall and floor tile
	3255	Clay refractories
	3259	Structural clay products, not elsewhere classified
326		POTTERY AND RELATED PRODUCTS
	3261	Vitreous china plumbing fixtures and china and earthenware fittings and bathroom accessories
	3262	Vitreous china table and kitchen articles
	3263	Fine earthenware (whiteware) table articles

Group No.	Industry No.	
	3264	Porcelain electrical supplies
	3269	Pottery products, not elsewhere classified
327		CONCRETE, GYPSUM, AND PLASTER PRODUCTS
	3271	Concrete brick and block
	3272	Concrete products, except block and brick
	3273	Ready mixed concrete
	3274	Lime
	3275	Gypsum products
328		CUT STONE AND STONE PRODUCTS
	3281	Cut stone and stone products
329		ABRASIVE, ASBESTOS, AND MISCELLANEOUS NONMETALLIC MINERAL PRODUCTS
	3291	Abrasive products
	3292	Asbestos products
	3293	Steam and other packing, and pipe and boiler covering
	3295	Minerals and earths, ground or otherwise treated
	3296	Mineral wool
	3297	Nonclay refractories
	3299	Nonmetallic mineral products, not elsewhere classified

Major Group 33 - PRIMARY METAL INDUSTRIES

Group No.	Industry No.	
331		BLAST FURNACES, STEEL WORKS, AND ROLLING AND FINISHING MILLS
	3312	Blast furnaces (including coke ovens), steel works, and rolling mills
	3313	Electrometallurgical products
	3315	Steel wire drawing and steel nails and spikes
	3316	Cold rolled sheet, strip, and bars
	3317	Steel pipe and tubes
332		IRON AND STEEL FOUNDRIES
	3321	Gray iron foundries
	3322	Malleable iron foundries
	3323	Steel foundries
333		PRIMARY SMELTING AND REFINING OF NONFERROUS METALS
	3331	Primary smelting and refining of copper
	3332	Primary smelting and refining of lead
	3333	Primary smelting and refining of zinc
	3334	Primary production of aluminum
	3339	Primary smelting and refining of nonferrous metals, not elsewhere classified

Group No.	Industry No.	
334		SECONDARY SMELTING, AND REFINING OF NONFERROUS METALS AND ALLOYS
	3341	Secondary smelting, refining, and alloying of nonferrous metals and alloys
335		ROLLING, DRAWING AND EXTRUDING OF NONFERROUS METALS
	3351	Rolling, drawing and extruding of copper
	3352	Rolling, drawing and extruding of aluminum
	3356	Rolling, drawing, and extruding of nonferrous metals, except copper and aluminum
	3357	Drawing and insulating of nonferrous wire
336		NONFERROUS FOUNDRIES
	3361	Aluminum castings
	3362	Brass, bronze, copper, copper base alloy castings
	3369	Nonferrous castings, not elsewhere classified
339		MISCELLANEOUS PRIMARY METAL INDUSTRIES
	3391	Iron and steel forgings
	3392	Nonferrous forgings
	3399	Primary metal industries, not elsewhere classified
		Major Group 34--FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, AND TRANSPORTATION EQUIPMENT
341		METAL CANS
	3411	Metal cans
342		CUTLERY, HAND TOOLS, AND GENERAL HARDWARE
	3421	Cutlery
	3423	Hand and edge tools, except machine tools and hand saws
	3425	Hand saws and saw blades
	3429	Hardware, not elsewhere classified
343		HEATING APPARATUS (EXCEPT ELECTRIC) AND PLUMBING FIXTURES
	3431	Enameled iron and metal sanitary ware
	3432	Plumbing fixture fittings and trim (brass goods)
	3433	Heating equipment, except electric
344		FABRICATED STRUCTURAL METAL PRODUCTS
	3441	Fabricated structural steel
	3442	Metal doors, sash, frames, molding, and trim
	3443	Fabricated plate work (boiler shops)
	3444	Sheet metal work
	3449	Architectural and miscellaneous metal work

Group No.	Industry No.	
345		SCREW MACHINE PRODUCTS, AND BOLTS, NUTS, SCREWS, RIVETS AND WASHERS
	3451	Screw machine products
	3452	Bolts, nuts, screws, rivets and washers
346		METAL STAMPINGS
	3461	Metal stampings
347		COATING, ENGRAVING, AND ALLIED SERVICES
	3471	Electroplating, plating, polishing, anodizing and coloring
	3479	Coating, engraving, and allied services, not elsewhere classified
348		MISCELLANEOUS FABRICATED WIRE PRODUCTS
	3481	Miscellaneous fabricated wire products
349		MISCELLANEOUS FABRICATED METAL PRODUCTS
	3491	Metal shipping barrels, drums, kegs, and pails
	3492	Safes and vaults
	3493	Steel springs
	3494	Valves and pipe fittings, except plumbers' brass goods
	3496	Collapsible tubes
	3497	Metal foil and leaf
	3498	Fabricated pipe and fabricated pipe fittings
	3499	Fabricated metal products, not elsewhere classified
		Major Group 35--MACHINERY, EXCEPT ELECTRICAL
351		ENGINES AND TURBINES
	3511	Steam engines; steam, gas, and hydraulic turbines; and steam, gas, and hydraulic turbine generator set units
	3519	Internal combustion engines, not elsewhere classified
352		FARM MACHINERY AND EQUIPMENT
	3522	Farm machinery and equipment
353		CONSTRUCTION, MINING, AND MATERIALS HANDLING MACHINERY AND EQUIPMENT
	3531	Construction machinery and equipment
	3532	Mining machinery and equipment, except oil field machinery and equipment
	3533	Oil field machinery and equipment
	3534	Elevators and moving stairways
	3535	Conveyors and conveying equipment
	3536	Hoists, industrial cranes, and monorail systems
	3537	Industrial trucks, tractors, trailers, and stackers

Group No.	Industry No.	
354		METALWORKING MACHINERY AND EQUIPMENT
	3541	Machine tools, metal cutting types
	3542	Machine tools, metal forming types
	3544	Special dies and tools, die sets, jigs and fixtures
	3545	Machine tool accessories and measuring devices
	3548	Metalworking machinery, except machine tools
355		SPECIAL INDUSTRY MACHINERY, EXCEPT METALWORKING MACHINERY
	3551	Food products machinery
	3552	Textile machinery
	3553	Woodworking machinery
	3554	Paper industries machinery
	3555	Printing trades machinery and equipment
	3559	Special industry machinery, not elsewhere classified
356		GENERAL INDUSTRIAL MACHINERY AND EQUIPMENT
	3561	Pumps, air [illegible] gas compressors, and pumping equipment
	3562	Ball and roller bearings
	3564	Blowers, exhaust and ventilating fans
	3565	Industrial patterns
	3566	Mechanical power transmission equipment, except ball and roller bearings
	3567	Industrial process furnaces and ovens
	3569	General industrial machinery and equipment, not elsewhere classified
357		OFFICE, COMPUTING, AND ACCOUNTING MACHINES
	3571	Computing and accounting machines, including cash registers
	3572	Typewriters
	3576	Scales and balances, except laboratory
	3579	Office machines, not elsewhere classified
358		SERVICE INDUSTRY MACHINES
	3581	Automatic merchandising machines
	3582	Commercial laundry, dry cleaning, and pressing machines
	3584	Vacuum cleaners, industrial
	3585	Refrigerators; refrigeration machinery, except household; and complete air conditioning units
	3586	Measuring and dispensing pumps
	3589	Service industry machines, not elsewhere classified
359		MISCELLANEOUS MACHINERY, EXCEPT ELECTRICAL
	3591	Machine shops, jobbing and repair
	3599	Machinery and parts, except electrical, not elsewhere classified

Group No.	Industry No.	
		Major Group 36--ELECTRICAL MACHINERY, EQUIPMENT, AND SUPPLIES
361		ELECTRIC TRANSMISSION AND DISTRIBUTION EQUIPMENT
	3611	Electrical measuring instruments and test equipment
	3612	Power, distribution, and specialty transformers
	3613	Switchgear and switchboard apparatus
	3619	Electric transmission and distribution equipment, not elsewhere classified
362		ELECTRICAL INDUSTRIAL APPARATUS
	3621	Motors and generators
	3622	Industrial controls
	3623	Welding apparatus
	3624	Carbon and graphite products
	3629	Electrical industrial apparatus, not elsewhere classified
363		HOUSEHOLD APPLIANCES
	3631	Household cooking equipment
	3632	Household refrigerators and home and farm freezers
	3633	Household laundry equipment
	3634	Electric housewares and fans
	3635	Household vacuum cleaners
	3636	Sewing machines
	3639	Household appliances, not elsewhere classified
364		ELECTRIC LIGHTING AND WIRING EQUIPMENT
	3641	Electric lamps
	3642	Lighting fixtures
	3643	Current carrying wiring devices
	3644	Noncurrent carrying wiring devices
365		RADIO AND TELEVISION RECEIVING SETS, EXCEPT COMMUNICATION TYPES
	3651	Radio and television receiving sets, except communication types
	3652	Phonograph records
366		COMMUNICATION EQUIPMENT
	3661	Telephone and telegraph apparatus
	3662	Radio and television transmitting, signaling, and detection equipment and apparatus
367		ELECTRONIC COMPONENTS AND ACCESSORIES
	3671	Radio and television receiving type electron tubes, except cathode ray
	3672	Cathode ray picture tubes
	3673	Transmitting, industrial, and special purpose electron tubes
	3679	Electronic components and accessories, not elsewhere classified

Group No.	Industry No.	
369		MISCELLANEOUS ELECTRICAL MACHINERY, EQUIPMENT, AND SUPPLIES
	3691	Storage batteries
	3692	Primary batteries, dry and wet
	3693	Radiographic X-ray, fluoroscopic X-ray, therapeutic X-ray, and other X-ray apparatus and tubes
	3694	Electrical equipment for internal combustion engines
	3699	Electrical machinery, equipment, and supplies, not elsewhere classified
		Major Group 37--TRANSPORTATION EQUIPMENT
371		MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT
	3711	Motor vehicles
	3712	Passenger car bodies
	3713	Truck and bus bodies
	3714	Motor vehicle parts and accessories
	3715	Truck trailers
372		AIRCRAFT AND PARTS
	3721	Aircraft
	3722	Aircraft engines and engine parts
	3723	Aircraft propellers and propeller parts
	3729	Aircraft parts and auxiliary equipment, not elsewhere classified
373		SHIP AND BOAT BUILDING AND REPAIRING
	3731	Ship building and repairing
	3722	Boat building and repairing
374		RAILROAD EQUIPMENT
	3741	Locomotives and parts
	3742	Railroad and street cars
375		MOTORCYCLES, BICYCLES, AND PARTS
	3751	Motorcycles, bicycles, and parts
379		MISCELLANEOUS TRANSPORTATION EQUIPMENT
	3791	Trailer coaches
	3799	Transportation equipment, not elsewhere classified